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Sworn to and subscribed before me this 17th day of October, 1960.

[SEAL] ALICE O. REDFEARN
(My commission expires April 14, 1962.)

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John A. Beckett

A New Look at ADP Systems

The experience with computers during the last ten years now provides sufficient background for critical evaluation of past work, thus permitting realistic planning of future applications of automatic data-processing systems. Within the government the major force in developing ADP has been the Interagency Committee on Automatic Data Processing. This group, composed of members from the twelve largest departments plus representatives from other interested units, has concerned itself with the many problems associated with extensive use of ADP equipment. In addition, the Bureau of the Budget and the General Accounting Office have jointly undertaken a number of studies, such as the problem of rental versus purchase, equipment sharing, development of a computer service center, and integrated data processing.

Mr. Beckett is Assistant Director of the Bureau of the Budget.

IN the environment of 1950 the very few people who knew the potential capabilities of the half-dozen or so computers then in existence had only one direction in which to look—that was straight ahead—and even to them the visibility was not wholly clear. By 1955 this situation had changed a little, but not enough to be meaningful to more than a select few. But in 1960, thanks to the pioneering efforts of several of our departments, we now have available enough hindsight and the results of enough practical experience to make it possible for us to begin to assess the past in order that we can be more realistic in our plans for the future.

This experience factor will become more and more meaningful as time goes on, because, of the approximately seven hundred computers in use today in business management, science, and engineering in the government, probably no more than 15 or 20 per cent have been in operation long enough to provide the basis for a logical assessment of our success in exploiting their full potential. But even with this small per cent it has been possible to formulate some useful guidelines and to identify numerous aspects of ADP utilization where guidance is lacking. In short, following what I would like to call the decade of development in data processing, we are at a logical point at which we should take careful inventory, a fresh and new look.

As with all pioneers, those in the vanguard of ADP utilization have seen some conceptual bubbles burst; the pioneers have also faltered at times; they fell into some traps because they did not know where those traps were. But they kept pushing ahead in the sure knowledge that this was the price of progress.

To all of these people most favorable recognition is due. Instead of indicting them for what we might now call errors of judgment, we should and do commend them for discovering errors we now know we must avoid. And it is as a result of the efforts of these ADP pioneers in government that we are able now to draft more realistic plans for the future, plans for action by the departments and agencies in their own behalf as well as by the central agencies for the government at large.

For the past several years in the Bureau of the Budget, and for longer periods in a few of the departments, programs for ensuring more practicable utilization of ADP equipment have been in the process of formulation. In terms of the government-wide efforts in this direction, I would like to identify for you a few of the special projects or studies which have been completed, are now under way, or are planned for the future. As I do so, you will note that the Interagency Committee on Automatic Data Processing is, and will continue to be, a major force in identifying and recommending courses of action for dealing with ADP problems of mutual concern and thus in helping to formulate guidelines which the committee members can then apply to similar problems within their own establishments.

An important fact about the committee is that a number of the

people to whom I earlier referred as pioneers—some of whom might now be called "elder statesmen" in the ADP field—are active members of the committee and thus are rubbing shoulders frequently with other members whose knowledge and experience is of shorter duration. Here are a few of the things which have already been accomplished:

1. In 1957 the Interagency Committee on Automatic Data Processing was established. It is composed of members and alternates from the twelve largest departments. Representatives from many other departments participate in its activities. This committee is chaired by a member from the Bureau of the Budget.

2. With the aid of the President's Management Improvement Fund, the Bureau of the Budget sponsored a study of the government-wide ADP responsibilities of the central agencies. The findings of this study constitute the framework upon which the ADP program of the government is being built.

3. A consulting firm was employed to study and report on the personnel problems involved in the use of ADP equipment. The findings resulting from this study have been quite useful in dealing with the ADP impact upon personnel administration in our agencies and government-wide.

4. Since its inception, the Interagency Committee on ADP has appointed task forces to study and report on a number of ADP problems. Reports have already been received by the Bureau of the Budget from the committee on such subjects as: *(a)* rental versus purchase of ADP equipment, *(b)* interagency sharing of equipment, *(c)* determining the costs of ADP applications, *(d)* a government-wide Information Exchange, *(e)* guidelines for studies to precede the acquisition of ADP equipment, and *(f)* a government-wide program for ADP orientation and training. As I shall point out presently, all of these reports have been or are being used as a basis for action.

5. With the help of the committee report on "Determining Costs of ADP Applications," the Bureau of the Budget last October issued a call to all government agencies for an inventory of ADP equipment, to be accompanied by indications of the uses being made of this equipment and the cost of its operation both in dollars and in people. These data have now been summarized and will soon be distributed throughout the government.

6. The committee report on "Guidelines for Studies to Precede the Acquisition of ADP Equipment" was transmitted in March of this year to all government departments and agencies with the suggestion that the report be used as a guide when ADP studies of various types are being planned or conducted.

Now let me identify some of the things under way:

1. Rental versus purchase. Picking up where the Interagency Committee on ADP left off, the Bureau of the Budget and the General Accounting Office are jointly engaged in a project for the development of policy and guidelines on whether it is more advantageous to the government, in all or some cases, to rent or to purchase ADP equipment. It is too early and too risky to forecast the outcome of this study, but I can say that there is a mounting body of evidence indicating that the practice of renting all ADP equipment as standard policy—a policy which seems to prevail in some quarters—may need to be modified in some degree.

2. ADP orientation and training. With the aid of the Interagency Committee report on ADP orientation and training, which we received just two weeks ago, a government-wide program will soon be formulated in this area. This program will of course take into account *(a)* the training work already accomplished by many of the departments, *(b)* the interagency ADP training courses and the ADP management intern program of the Civil Service Commission, as well as *(c)* the additional training and orientation needs we now recognize. This additional training I speak of includes the needs of many of the top-level officials of government for a better comprehension of the capabilities and limitations of computers and the impact computers can have upon the organization and operation of their agencies, upon the people employed, and upon budgets. This training also includes recognition of the fact that a fair proportion of the people who perform the systems analysis aspects of computer utilization are in need of some additional training. I may state to you that in most other respects, as in the case of computer programmers and operators, for example, there are indications that the departments and agencies have these training requirements well in hand and that no interagency government-wide concentration of effort seems necessary.

3. Computer service center. About a month ago we in the

Bureau of the Budget started a study to determine whether or not the need to establish one or more computer service centers in the government truly exists. If it appears that sufficient requirements exist to keep such a center (or centers) busy, then as a further objective of this project we will proceed with the help of appropriate agencies to draw up a set of definitive plans, specifications, and procedures as to how to organize, finance, staff, equip, and assign responsibility for the operation of an *experimental* service center. During this second phase we will deal also with such factors as service charges, economic feasibility, and competition with private business. We expect to finish this project in November of this year.

4. ADP Committee reorganization. In consultation with the members of the Interagency Committee on ADP, we in the Bureau of the Budget are currently studying possibilities for assuring that the committee will continue to improve its effectiveness as *(a)* a medium for the interchange of ideas and information, *(b)* a forum for the discussion of mutual problems, *(c)* a proponent of new or revised government-wide guidelines for ADP operations, and *(d)* an advisory body to the Bureau of the Budget and others on the form and shape of things to come in the ADP program of the government. A subcommittee has prepared and submitted recommendations for the organization and future role and program of the full committee. These recommendations are now under consideration.

5. Sharing ADP equipment within and between departments. The *intra-agency* sharing of ADP equipment time seems to be gaining momentum in some of the agencies where top leadership has recognized the operating and economic advantages of this practice. Equipment sharing has its problems as well as it benefits, as the committee task-force report which I referred to earlier appropriately points out. But a determined leadership will bring about *desirable* equipment sharing in any agency—not sharing solely for the sake of sharing.

The data we obtained recently on *interagency* sharing of ADP equipment—and similar data we plan to obtain from year to year—will serve to aid us in fostering and promoting a practicable degree of interagency sharing of ADP equipment.

6. Integrated data processing—which we all know as IDP—is, I note with enthusiasm, a significant part of the deliberations of this symposium. Integrating data for the use of supervisors and executives has always been a challenge, at least to the few who have worked at it. But today it is a challenge to all who are engaged in data processing, particularly to a group like yours which is primarily interested in financial management data. We once had some rather valid excuses for not integrating data of several types, but in today's environment none of those excuses are legitimate. Certainly we now have the hardware to do it with. And where that hardware and man's ingenuity and determination have teamed up, we have found or are on the road to finding the answers we need.

The accomplishments to date in IDP in the government are perhaps not as significant as the breakthroughs that are impending. But they are significant in the sense that we are learning about IDP by solving the less-complex problems. For example, in a number of agencies today you can find instances in which a pattern has been found for integrating several types and categories of administrative resources data. Information about manpower, money, and matériel are processed in one system and, at times with production data added, are interrelated in ways that are far more meaningful to management than they were before integration took place.

There are bigger things to be done, however, in fields which involve the creation of integrated data-processing systems for very complex management problems. Around the government, particularly in the military departments, work on problems of this type is already under way or is being planned. Take the Navy, for instance, which in its air program must procure, maintain, overhaul, convert, and assign aircraft to operating units. For about as long as the Navy has used aircraft it has had one organizational unit which decides what aircraft will be bought, how many, and when. Another unit decides which aircraft to convert and when. Still another develops the plans by which aircraft are allocated to operating units. And, finally, other organizational units make arrangements for and decisions on maintenance, overhaul, operating support, manpower, and money. Since to a very large extent each of these organizational units generates for itself the data it

uses to manage its aspect of the Navy air program, the most elaborate co-ordinating machinery must be used to achieve acceptable consistency among the various units in plans and operations. The Navy recognizes that, despite the vastness and complexity of these interrelated activities, significant improvements would seem to be in store if for purposes of data processing the entire air program could be considered as a whole. In terms of data integration, I suspect we would be hard put to find a problem more complex or more challenging than this. You can be sure the Navy will find the right answers. It will take time and a great deal of ingenuity. I suspect that some considerable reorganization may be in store. They probably will have to develop computer routines unlike any the experts have so far devised. But a logical and usable answer to data-integration problems of this magnitude is on the horizon. For the lesser IDP problems, answers are available now if we but look for them.

7. Interagency integration of systems. Another subject engaging our attention today, which holds great promise for the future, is the *interagency* integration of systems. I can explain that term by an example. The Veterans Administration processes claims of veterans and their dependents for benefit payments under the GI Bill of Rights. Approved claims are turned over to the Treasury Department for checks to be written, and these checks, stuffed in envelopes, are turned over to the Post Office Department for delivery. By voluntarily working together on their three separate systems and by exploiting to the full the use of ADP equipment, these departments have worked out an arrangement whereby in the near future the magnetic tape developed by VA for benefit payments will be used also by Treasury for check writing; and in the preparation of this same tape, VA also will insert address codes which will make possible a mechanical presort of checks by locations, thus speeding the work of the Post Office Department.

There are other examples, such as the collaboration of the Treasury Department and the General Accounting Office in reconciling government checks—with appreciable savings in processing time and costs and with a higher degree of accuracy than was ever before possible.

We in the Bureau of the Budget are mounting a continuing

campaign to exploit the many possibilities that must exist for interagency integration of systems. We know that the agencies also will lend their full support to this kind of integration, because the potential pay-off will make it worth their while.

Now let us look ahead a bit. Where is the government headed in ADP and in IDP? In terms of the so-called ADP program of the government, what is in store? How fast or how slow should government go in employing ADP equipment? What are the problems we have yet to face? Final answers to these and other questions are not easy to supply in the environment of 1960, but interim answers are now available and will be replaced as fast as possible with more definitive answers. In this connection, what I have said so far should be interpreted to mean these five things:

First, that the Bureau of the Budget *has* a program for supplying administrative leadership in ADP utilization in the government and will implement that program vigorously. All of our people—budget examiners, management analysts, statisticians, and accounting personnel alike, as well as the Director and his key assistants—are aware of the potential of ADP equipment for management improvement in the government. A small staff of ADP specialists is being enlisted and organized to provide to the Bureau and to the agencies the general over-all guidance and assistance needed as we move forward to exploit that potential.

Second, as determined as we are for the government to move ahead in its exploitation of this new and rather fantastic equipment, we are equally determined that the pitfalls of the past and the new pitfalls to be encountered in the future will adequately be considered by the agencies and our own staff when ADP applications are being planned.

Third, in the Bureau of the Budget we expect no special or additional controls on individual ADP applications. The normal budget-review process, long established, will continue to be our primary means of reviewing ADP applications. The underlying concept in the government's ADP program and in our plans for giving leadership to that program is that we shall advocate and energetically support sound programs in the departments and in their bureaus for the management of their ADP equipment utilization. It has to be that way because no matter how effective the

Bureau of the Budget or other central agencies may think they are in their over-all leadership, if we do not achieve good ADP management at the departmental level and lower we just do not have good ADP management.

Fourth, in the statistical and reports-control programs of the agencies, and in the statistical standards activity of the Bureau of the Budget, we feel that the use of ADP equipment offers an opportunity to deal more effectively than ever before with one of the long-standing and perplexing problems of management, namely, supplying accurate data to those who as supervisors and executives *need* and *will use* these data to make *informed* decisions. ADP does nothing if it does not assure an orderly flow of meaningful data *for use* in more effectively managing the multifold activities of our federal government.

In seeking to provide this, those who help to engineer the changes had best avoid becoming enamored of hardware. It is not hardware that gets the job done; it is systems, conceived in breadth and developed with clear objectives in mind. He who gets a fixation on equipment—what I would like to call "hardware hypnosis"—is in for trouble. Data development is *systems oriented,* not machine oriented, and when you ask too much of a machine, or distort your needs to fit equipment, to that extent are you unfaithful to the task ahead of you.

Fifth, as we in the government move ahead in the ADP program, one very necessary ingredient must be present. This ingredient is essential in almost any program, but in ADP it is indispensable. I am talking about common purpose, co-ordination, co-operation, or teamwork. When ADP equipment is being considered in any one of our departments, in some of our large bureaus and local installations, and certainly in the government as a whole, organizational lines, functional lines, geographical lines and even professional lines, which have presented barriers to efficient data processing systems in the past, no longer can be permitted to be barriers to effective data processing. If we pursue the broad systems approach, as we must; if we actually integrate data-processing systems, which is inevitable; if we co-ordinate and integrate systems on an interagency basis, as we have already begun to do; then compartmentalization will have to stand aside, artificial boundary lines will

have to disappear, and experts in science, engineering, finance, accounting, logistics, personnel, management analysis, and many other functional or professional fields will find that the only course to follow is one which involves a common effort.

There is a moral in this for a group of federal government accountants like yourselves. It is this: Whatever your philosophy about financial management data may have been or now is, that philosophy must recognize the mounting evidence which proves that although financial management data are indispensable to the federal executive, their value to him will be almost in direct proportion to the extent to which those data have been integrated with other-than-financial data. These various types of data do not integrate themselves. You, as the financial members of an integration team will, in a joint endeavor with the other members of your team, bring about that necessary integration. It is a great challenge and an exciting one for you and for all of us.

I want to be sure that what I have thus far said does not leave the impression that the things we need to accomplish in ADP utilization will be easy. On the contrary, even with the finest cooperation of all of government and all of industry there are many problems yet to be faced. I have already mentioned some. Among the others we now recognize, here are a few:

1. The centralization-decentralization problem. This is one we have had for years, of course. It has a habit of cropping up frequently. And now with computers we in many cases may have to reconsider our last decision on this problem. ADP equipment encourages centralization of data processing; as a matter of fact in some cases the justification for acquiring ADP equipment becomes valid only if centralization takes place.

2. The ADP equipment compatibility problem. This problem likely will plague the federal government for a long time to come. However, some inroads already have been made; for example, the study sponsored by the Department of Defense, with aid from the equipment manufacturers, has produced COBOL (Common Business Oriented Language), which under proper conditions can be used to overcome in part some of the incompatibility questions many of our agencies face. But there are more aspects of the incompatibility problem. I am sure we can count upon the manu-

facturers to work with the government toward a solution of every aspect of the problem.

3. The vulnerability problem. Since we are staking so much on the capabilities of our computers to process data essential to the continued operation of government functions that are as necessary in wartime as in peacetime, we have a big job ahead to assure the preservation and continued operation of our equipment under all conditions and at all times. As in the compatibility problem, we have made some progress in dealing with the matter of vulnerability, but we have a long way to go to solve this one.

4. The progress assessment problem. How effectively have we used ADP equipment in the government up to this time? Finding answers to this question has been both difficult and enlightening when we use the few criteria so far developed for assessments of this kind. As yet we have not enough criteria, and we are not fully confident that the criteria available are the right kind to use. But with the help of the departments, some of which have already begun to develop assessment procedures, a pattern will soon be developed for evaluating progress and status in the utilization of ADP equipment. You can well understand why we in the Bureau are anxious to reach the point at which we and the departments have developed tried and proven goverment-wide procedures for assessing progress in ADP utilization.

I have thus far given you some of the findings resulting from the limited evaluation measures which have been employed to date. Here are a few more findings. (*a*) Almost invariably, ADP costs are underestimated. Variances run as high as 50 per cent over budget expectations. This is due to several causes such as underestimation of machine time required; failure to allow for set-up time, down time, and maintenance; and the fallacious assumption that workload will remain constant, which rarely occurs. (*b*) The purposes behind the acquisition of a computer are often so vague or general as to leave the impression that the real purpose is to get the computer first, then figure out how to use it or what to use it for. In enough cases to cause alarm, this is substantially what has happened. I am sure you will agree that before we get computers we ought to have specific plans for their use. (*c*) Computer programming, systems analysis, and the writing of instructions

with rare exceptions take longer than expected—sometimes over twice as long. (*d*) There seems to be a general tendency to overlook certain cost items when estimates are made, for example, supporting equipment, building modification, training, and travel. (*e*) Punched-card equipment due to be given up when the computer is installed somehow is not released in some cases. And in many cases punched-card or manual systems due to be discontinued are not, so we end up with duplicate systems. (*f*) In cases involving parallel operations, that is, when the new ADP system and the old system operate concurrently until the new system is thoroughly debugged, we find that more often than not the period of parallel operations is excessive—six months, for example, when one or two months would be ample.

5. Balance of use. The uses of computers may be put into five major categories: business management, science, engineering, military operations, and intelligence. In the first of these categories, business management, we find that the trend in ADP utilization to date has been to concentrate upon the administrative type of system—such as payroll, personnel accounting, cost accounting, appropriation accounting, inventory accounting, and the like—while the substantive operations of many of the agencies have been ignored or intentionally set aside for the time being. This kind of imbalance was to be expected. It is also to be expected that the agencies will do something about it soon. The fact that the Interagency Committee on ADP has also pointed to this imbalance is a good sign that it will be getting the proper attention. At this point in time we are not sure of the kind and degree of balance that now exists or should exist between the five categories of use I have named. We are studying this now.

Please do not get the idea that our findings are all as unfavorable as the ones I have been describing. On the contrary, there are numerous ADP applications to which we can point with some measure of pride. Many novices and neophytes in the ADP field are consistently being urged to visit these and other "going" operations in order to see at first-hand how computers have been geared up to do a creditable job.

Certainly, not all ADP applications will always be models of efficiency. But we are learning fast, and we firmly believe we have

occasion even now to be confident that on the whole, throughout the federal government, we are going to do even better than a creditable job in applying ADP equipment to our operations. I feel certain that you as individuals, your Association, and the departments you work for will make significant contributions to that ambitious goal.

Sumner G. Whittier

A Large-Scale Integrated Government Application

The Veterans Administration is one of the largest agencies in the federal government, having more than 170,000 employees and directly serving some 22,500,000 veterans and their families. Its activities include the operation of a life insurance program, a network of hospitals, a compensation and pension program, a home loan program, and an education and training program. As a means for effectively administering such a vast and diversified organization, the VA has turned increasingly to the use of electronic data-processing equipment as a management tool. Proper accountabilities serve as the basis for administrative control. Computer applications now provide more complete information faster than any other means known heretofore. In time it is expected that all major VA functions—finance, supply, payroll, and personnel—will be served by machine.

Mr. Whittier is Administrator of Veterans Affairs.

NOT all the significant events of the world wind up in history books. I can name four that deserve to be at least footnotes; four that our children do not study in school; four that were responsible for bringing us together today. The first goes back to the dim, early days of China and Greece, hundreds upon hundreds of years ago—the invention of the abacus, man's first attempt to progress in computation beyond the limits of his fingers and toes and the collection of pebbles he kept handy for the purpose. The second goes back to a date nobody remembers—1642—the year the adding

machine was invented by that jack-of-all-trades and master of them all, philosopher, mathematician, essayist Blaise Pascal. The third was the discovery by the United States Census Bureau, back in 1890, that made it possible to count the noses of Americans a lot faster by punching holes in small pieces of cardboard—the first punch cards in history. And now a fourth—electronic data processing—so new that we still do not fully comprehend it, and yet so old, for its ancestors are the abacus, the adding machine, the punch card.

We are rapidly finding out more about this last discovery, the ability to process, sort, and classify large volumes of data electronically. We are studying its capabilities, its vast power. As we probe the full meaning and implications of those newest initials in the American alphabet soup—ADP, EDP, IDP—we find that something very strange is happening. As we discover new ways to adapt the machine to our needs, we find that we—the human beings, the creators—must adapt ourselves to the machine. I do not believe that accountants have any choice in the matter. My prediction is that those new initials will change the very nature of your job. They will add new challenges. They will relieve you of routine report making and will place squarely in your laps much more critical and demanding tasks of analyzing and interpreting reports. My prediction is that you will have to learn a great deal more about all the interrelationships and functions of your agency than you need to know at present. Data processing cuts across division lines; to be truly effective, it must be truly agency-wide. My prediction is that in the future the formal education of an accountant will have to place much greater stress on clear, logical decision making. I do not imply that accountants do not think clearly and logically at present. But the machines will demand much more of it. Finally, my prediction is that accountants will have to develop traits of imagination and creativity as never before. You must probe here, there, everywhere—the off-limits, unexplored areas as well as the explored territory.

As you no doubt have surmised by this time, I am an ADP enthusiast. I know nothing more about the insides of the machine than I do about the insides of my television set; but I do know what it can do for management. And when I speak of management,

I include those most essential members of the management team, the accountants.

You will discover what makes me an ADP enthusiast as you listen to this story of the Veterans Administration and the part that ADP plays in the agency. The VA—and this is the understatement of the year—is quite large. Administering the VA is not at all like running a corner grocery store. It is the third largest agency in the government; in terms of money it spends some $5.5 billion a year. It employs more than 170,000 men and women. It serves more than 22,500,000 veterans and their families—all of whom make up about 45 per cent of the population of this great country. It operates the second largest ordinary life insurance business in the world. It operates the largest network of hospitals in the United States. It operates a multibillion-dollar compensation and pension program that accounts for three-fifths of our entire budget. It conducts a GI loan program that has been responsible for the construction of every sixth home in America. It administers an education and training program that has given more than 10 million veterans a chance to prepare for new careers. Yet despite its vastness, the VA has been able to bring down its overhead administrative costs to a mere three cents out of every dollar. As you will see later, ADP has had a hand in this remarkable record.

It takes paper work to run an operation of this scope; in fact, sometimes you think you are sitting on a mountain of paper—thousands of acres of files containing vital records of veterans—insurance records, medical records, educational records, loan records, without which there could be no veterans' programs and benefits. What would we do without records? Rely on our memories? It takes millions of letters to conduct VA's vast affairs—94 million coming in, 80 million going out, every year. This is more mail than is handled by a city the size of Pittsburgh. There may not be a VA office in every city in America, but there is a mailbox. How do we cope with this paper work? Largely through ADP. What is more, the VA has been a user of ADP for a long time. We have been processing data on punched cards ever since 1922, when we were known as the Veterans Bureau. And today, we use punched cards extensively for many operations.

When electronic computers came on the scene, we could see that here was a new dimension in data processing. Only we were not in any hurry to rush to our nearest dealer and place our order. We studied our operations in the new light of EDP. We mobilized our best and brightest men. We planned and tested and studied and worked over thousands of ideas. And only after many months did we conclude that, yes, EDP could be used in our daily work. Our studies told us something else, that IDP and EDP are more than kissing cousins; they are both part of the same thing. If you do not intend to integrate your EDP operation, and get the widest possible use out of it throughout your agency, you might as well save your dime and not telephone your order.

Well, then came that happy and proud day in November of last year, in Philadelphia. We dedicated our first large-scale electronic data-processing operation. It was geared to handle the records of some six million GI life insurance policies. It is enough to make you shake your head in disbelief to hold in your hand a length of magnetic tape the size of your thumb nail and to realize that recorded upon it is all there is to know about a veteran's insurance policy—his name, age, address, insurance number, type of policy, amount of premium, amount of dividend payment record. All there, in the half-inch of tape resting in the palm of your hand.

But that is only half the miracle. Here we have a master tape, but how do we keep it up to date? Data involving insurance transactions come in every day. And every day it is transferred to the master tape—yes, every day, a brand new master tape. In the updating process, the busy computer tends to a few other matters at the same time, handling premium billing and accounting, loan accounting, dividend accounting, lapse processing, renewal of term insurance, allotment and deduction accounting, and much more besides. Many sets of eyes are watching this system closely, for it has the distinction of being the most extensive computer application ever undertaken by any major life insurance organization.

With our first electronic venture on its way, we found we had no time to sit back and admire our handiwork. We were in the midst of another large-scale conversion to electronics—the payment and the record keeping of VA's huge disability and death compensation and pension programs. Here were challenges anew:

$3 billion a year in payments; 4,700,000 checks to be sent out each month, and on time; another 4,700,000 separate payee accounts to be maintained; varying rates of payment. Challenges exist to be met head on, not ducked; and we have been meeting them.

We established a VA Data Processing Center at Hines, Illinois, just outside of Chicago, and installed our second computer in December of last year. Some day they are going to put Hines on the map in big, capital letters—not just because we run a fine VA center there, but because it is becoming the core of our data-processing activities. Its first task will be the payment and record keeping of compensation and pensions. Things will work this way: Each of our Regional Offices will continue to adjudicate claims and keep veterans' case records—for, machine or no machine, we must never forego personal contact between veteran and VA. But the Regional Office will not make payments. This will be done by the machine at Hines by reading a magnetic master tape of all 4,700,000 on our rolls.

This tape will be kept up to date in a most ingenious manner. Any time a newcomer goes on our rolls, or a payment must be changed, the Regional Office prepares a letter on a special typewriter called the flexowriter. While this machine is typing words for humans to read, it is typing the identical information on paper tape for the machine to read. This paper tape goes to the Hines Center, where it is merged with hundreds of other paper tapes from all over the country and is incorporated in the master. That is not all. From our master we will make another tape which we send to the Treasury Department. Treasury will put this on its own machine, and the checks will come forth faster than the eye can see, neatly sorted by state and city for extra-fast Post Office handling. Thus one machine works for three agencies of the government.

As you have surmised, conversion to the machines does not take place overnight. We are moving ahead steadily. We hope to complete the conversion task, both in Philadelphia and Hines, sometime in 1961. At this point I imagine some of you are asking: "What happens to the accountant and the auditor? Now that you have the machine, what do you do with the man?" I wll tell you. We provide service to human beings—to veterans, to their widows

and children—who look to VA as their very lifeblood. We cannot concern ourselves only with speed and economy. Our greatest concern, for their sake, has to be accuracy. And so we have turned to you—the accountant, the auditor—to introduce safeguards against error.

The accountant has been in the picture from the start. You can detect his practiced hand in such things as record and money controls, built-in consistency checks, audits and edits that detect out-of-line situations. We called in the auditor for an independent analytical job. He frowned over the machine; he studied this feature and that; he made a list of additional areas of safeguards—and meantime, a great number of VA technicians were holding their breaths awaiting his decision.

There you have the VA story, chapter by chapter. Faster, more accurate, more economical service. We expect our computers to save the government perhaps $5 million a year. There is a moral to this story. Accountants, whether they like it or not, no longer are living in the adding machine age. This is the emerging age of the computer. New attitudes are required, fresh thinking, a break-away from the old-time viewpoints and accounting controls.

Somehow, when you become involved with the computer, you cannot help but look ahead to the future. When we do, what do we see? We see VA functions which cut across the agency—finance, supply, payroll, personnel statistics—served by the machine. We see the huge VA payroll served by the machine—and this will be no simple task, for our employees are paid under several systems. We see our vast supply program served by the machine—and if you can imagine the hundreds of items necessary to maintain a single VA hospital, you can get some notion of the size of this task. And then, when we raise our eyes still higher, we see something else, something bold and daring—the marriage of the electronic computer and medical research, for the purpose of saving lives, restoring health.

That day is not as far off as you might believe. In our hospital in Los Angeles, our doctors have turned to EDP to analyze case histories of a certain type of infection of the valves of the heart. It took ADP only hours to analyze the relationships of 250 variables in each of the 86 cases under study. It would have taken

human beings years to do the same job. In Washington, a demonstration took place not long ago of what EDP can contribute to the study of heart disease. A research team of VA and National Bureau of Standards scientists showed how electrical impulses from the heart can be recorded, converted to numbers, fed into the computer, and give the doctor a more thorough, revealing picture of the heart than he could ever have received before.

In our explorations in the magic land of ADP, we have come to two conclusions in the Veterans Administration. The first is that there is something far more important than the machine. It is a far more intricate mechanism called man. In all our dealings with the machine, we do not ever forget that it did not create itself; it was created by man. It does not operate itself; it is operated and programmed by man. So long as man remains uppermost in your thinking and planning, you will achieve success. The second conclusion is that this machine, and the marvelous uses to which it can be put, can go a long, long way in changing the image of government from that of stodgy red tape to the progressivism of magnetic tape. And it is about time something happened to change the image.

Joseph J. Guidrey

A Large-Scale Integrated Data-Processing System

Although Sylvania Electric Products, Inc., operates under a system of decentralized management, its data processing has become highly centralized, resulting in more efficient operations through more meaningful and faster information to operating personnel. Centralization of data processing has been achieved by establishing a central processing unit which serves the various divisions of the company throughout the nation. A private wire network provides the communications link between the computing center and the operating units, which are at 97 different locations. Through a gradual process of expanding computer applications, it is expected that within a reasonably short period of time data processing for all functions in the company will be integrated and centralized.

Mr. Guidrey is the Manager of the Data Processing Center at Sylvania Electric Products, Inc.

BEFORE I get into the details of our highly integrated data-processing system, I think I should tell you something about Sylvania. This background may help to give you a clearer picture of why we do what we do in data processing. One of the predecessor companies of Sylvania started in 1901 as a manufacturer of light bulbs in Middleton, Massachusetts. The other began operation in Pennsylvania in the same business in 1906. Both companies expanded

into radio tube manufacture in the late 1920's. The two companies merged to form the nucleus of Sylvania as it is today. This corporation grew by expansion and acquisition from sales of $5 million in the year of merger to over $400 million in 1959. During this period, Sylvania acquired the Colonial Radio Corporation, which now is Sylvania's Home Electronics Division; the Wabash Corporation, a flash-bulb manufacturer, which is now part of our Lighting Division; and Argus Cameras, Inc. In March 1959, as you may recall, Sylvania merged with the General Telephone Corporation and is now a subsidiary of General Telephone & Electronics Corporation.

Sylvania has approximately 30,000 employees in 8 operating divisions, under which there are 45 manufacturing plants, 19 laboratories, and 29 distribution centers and sales offices. These are located in 14 states from coast to coast, but primarily in the states of New York, Massachusetts, and Pennsylvania. Our Lighting Division manufactures incandescent, fluorescent, photoflash, and projection lamps. It is the third largest manufacturer of incandescent lamps and second largest manufacturer of fluorescent lamps. It is the largest manufacturer in the world of photoflash and projection lamps. Our Electronic Tube Division is one of the two major producers of receiving tubes and television picture tubes in this country. Our Home Electronics Division is a major producer of television, radio and high-fidelity sets. Our Argus Cameras Division is one of the foremost producers of 35-millimeter cameras and projectors and 8-millimeter movie cameras and projectors. Our Semiconductor Division is a major supplier of transistors, diodes, and other semiconductor devices to the home entertainment and industrial markets. Our Electronic Systems operation is a major participant in a wide variety of research and development projects for the Armed Forces involving extremely advanced concepts. In 1959, Sylvania's defense business exceeded $100 million or about 25 per cent of total sales. This division also produces data-processing equipment for the Army and probably, someday, may market specialized types of this equipment on a nonmilitary basis.

Sylvania is vertically integrated to a substantial degree, and our two supply divisions produce a large percentage of the components

and materials which go into our end products. One of these divisions is our Chemical and Metallurgical Division, a producer of tungsten and molybdenum wires for lamps and phosphors for picture tubes and fluorescent lamps. The other is our Parts Division, which produces metal and plastic components for lamps, tubes, radios, and television sets.

As you can see from the list of products I have mentioned, Sylvania is engaged in many businesses. We operate under the philosophy of decentralized management, with operating and profit responsibility chiefly in the possession of division management. While general policies have been laid down by central management, the implementation of these policies has been left to each operating division. We see no reason to believe that because a company is decentralized from an operating standpoint, its data processing must also be decentralized, and we are convinced that centralization of data processing is completely consistent with the decentralization of responsibility for the simple reason that it makes decentralized operations more effective by providing more meaningful and faster information to the operating personnel. Possibly the most significant difference between Sylvania's approach to the data-processing activity and that taken by many other large companies is the fact that we have centralized our data-processing activity for the entire company in a single building built especially for the purpose at Camillus, New York. This building is the financial and accounting center of Sylvania. Here are located headquarters of the computer group, the private wire network, the general accounting group, the Tax Department, the Internal Auditing Department, the Credit and Collection Department, and the Warehousing Department.

The private wire network established at Camillus ties together all of our plants, laboratories, warehouses, sales offices, and the home office—a total of 97 locations. It consists of 20,000 miles of circuits with switching centers at Kansas City and Camillus. We lease this system from Western Union on a 12-hour-a-day basis, and it is staffed by 20 persons. It carries over one-half million words a day of data processing and administrative traffic with the data-processing load half again as heavy as the administrative traffic load. All our locations are as close to one another as the nearest

teletypewriter. As an example of the flexibility this system permits, a customer's purchase order received at any warehouse is transmitted to the proper billing center immediately upon notice of shipment, thereby enabling us to prepare the invoice and update our inventory records at the earliest possible moment. We were not the first company to tie together all of its facilities from a communications standpoint, nor were we the first to use an electronic computer to process business information. However, we were the first to combine a private wire network and an electronic computer at a single location on a company-wide basis.

Sylvania not only preaches the philosophy of decentralization but practices it. We work on the basis that every decision must be made at the lowest possible level at which a good decision can be made. We do not believe that our wire network and large-scale computer will encourage centralization of management with minor decisions being made at higher than necessary levels. On the contrary, we feel that it will make decentralized management even more effective, because experience has proved that, the lesser time an operating manager spends preparing records, the more he has available to spend in managing and improving his operations.

The data-processing center is strictly a service department with the responsibility of gathering data from the operating divisions, processing it and transmitting information back to the divisions in the form most helpful to them. The data-processing management does not make any decisions concerning the operation of any of our product divisions. Camillus began operations on a full-scale basis in the fall of 1956. The first complement of equipment consisted of a large-scale computer, eleven servos, a card to magnetic tape converter as an input agent and a high-speed printer for output. The unused time on this equipment was continually absorbed by additional applications and increased volume, and by June of 1959 it was loaded. This was replaced by a computer with even more capacity, with twelve servos and two buffered high-speed printers on two and one-half shifts a day, five days a week in the middle of a month and six days a week at monthly and quarterly closings. This equipment has two to four times the work capacity of our earlier equipment, so you can see that our volume has increased substantially during the past year. We have

had excellent experience with all our equipment after it was adequately shaken down.

From the inception of the Data Processing Center, the number of programmers and system analysts has varied between fifteen and forty. Today, we have thirty-five, about one-third of whom concentrate on maintaining present programs to meet new legal or operating requirements, and the remainder concentrating on new applications.

As so often has been the case with other companies which are using a computer for data processing, the first application we standardized was payroll. Previously, this function was performed in many different locations in many different ways. After the overall system was defined and programmed, the payrolls were transferred to the central computer, one at a time, over a period of a few months. Because of the wide dispersion of our plants—from Maine to California—the various delivery times necessitate that we have five pay areas or, to say it in another way, five separate payrolls to process. This input to the payroll system is transmitted over our wire network on an exception basis and presents no problems. We deliver the checks by airmail, air express, or courier. We are looking for an economical method of transmitting the information required to write the pay check direct to the paying location and having the check prepared in the field, but so far without success. We have had a few anxious moments when pay checks were mislaid in transit or planes grounded, but in no instance have we missed a payday at any location in the past three and one-half years. Today we prepare and issue 125,000 checks a month and at the same time prepare the myriad of reports covering all the reporting requirements of federal and state governments and our Insurance and Industrial Relations Departments. As an example of the speed of our payroll operation, our W-2 and similar statements for the various state withholding taxes were available for distribution to our 30,000 employees a few days after the closing of 1959.

The next large application to be placed on the computer was accounts payable. This function was first centralized on electric accounting machines and then programmed to the computer. The computer digests 60,000 invoices a month from over 10,000 ven-

dors, calculates the allowed discount, combines invoices from the same vendor, and prints out checks in payment on the date determined by the purchase terms. In addition, this application provides a cash disbursement forecast by days, the expense distribution to ledger accounts, local plant purchasing agent's reports, and an analysis of purchases from vendors who are also our customers. It has enabled us to reduce the number of checks we issue to one-half the former volume, which results in significant savings in check costs and in labor previously spent in preparing disbursement records, expense distribution records, and reviewing vouchers and in reconciling bank accounts.

Next, we programmed accounts receivable. As in the case of accounts payable, this function had been standarized and centralized on electric accounting machines a few years earlier. The first phase of this project was to computerize the monthly statements to provide the Credit and Collection Department with account agings by individual customers and to get the statement to the customers at an earlier date. The second phase entailed putting the details of each of our 11,000 customers' accounts on magnetic tapes. These details average over 170,000 invoices rendered and payments received each month. Today the details of our accounts receivable operation, totaling some $75,000,000, are on magnetic tape. We believe we were one of the first companies to succeed in programming the complete accounts receivable function to a computer.

One of our newer applications pertains to our inventory of personnel. We are setting up, on magnetic tape, detailed information on the education and experience of each exempt employee. When the Industrial Relations Department is looking for the right man for a certain position, this file can be searched to develop a list of the best-qualified candidates.

The applications I have described serve the entire corporation. We have under way a program covering the general ledger accounting for the corporation which we expect to have in operation by the end of the year. It is very possible that our fixed asset accounting will be next in line for the computer. We already have this function centralized on EAM equipment at Camillus.

We are all aware that the optimum of economy is derived from

a data-processing system when the volume is large. We have also found that in a large corporation not only those applications which are uniform for all divisions can be profitably placed on the computer but also those of individual divisions when the volume is sufficiently large. We use computers for sales analysis reportings for one of our larger divisions. This application comprises some 180,000 transactions a month with an output of thirty different reports to various levels of field and top management. We are now in the process of attempting to make uniform our sales analysis reports to make this program applicable to other divisions.

Another single-plant application being performed at Camillus is a material control program. This system, working from bills of materials, purchase orders, and receiving notices, computes materials availabilities, determines net requirements, follows up the status of the purchase order, the delivery and inspection of materials, and issues from the stock room on a dated exception basis. This application was our first excursion into the field of operations control, and we expect it to be adaptable to many other of our manufacturing plants. Nearly 100,000 parts are listed in the files, and we update them with two hours' computer time every other day. This application has been in successful operation for a month and is providing information to local management more timely and more accurately than was possible under the previous method.

We have always followed the practice of storing on tape at a reasonably distant location all information which would be required to reconstruct our records if the need arose. From our experience to date, we have learned four important lessons which we consider essential if an operation is to be successful:

1. The problem must be fully defined before any attempt is made to start programming. All too often a superficial study of a projected application is made and then programming is started. We have found that the best approach has been to use the corporate supervisor, in co-ordination with the systems analyst, to determine the output requirements after personal interviews with those concerned with the operation at the working level. At this point it is the responsibility of the systems analyst to determine the input and file and the most economical method of processing.

2. Once the programming is under way, there must be a point after which no further changes can be accepted. It is common knowledge that a programming group is best prepared to start programming an application just as soon as it has completed the same application. At that time all the pitfalls are known which would have been nice to know at the beginning. If a program is altered every time a better way to do a certain phase of it is discovered, I can assure you that the program will never be completed.

3. Do not program a function along present lines merely to get it done faster. This approach deprives the user of the capabilities which all computers hold over other data-processing equipment, for which he is paying a heavy price.

4. Plan to retain at least one programmer on each new application to keep it up to date. Our experience has indicated that changes will always be required to keep up with the needs of a dynamic business.

The real economies a computer can return to a user lie in the integration of record-keeping and reporting activities. Our goal at Sylvania is a completely integrated system on a single large computer with or without satellite computers, depending on the day-to-day data-processing needs of the company and the progress made by manufacturers in the data-gathering and data-transmitting equipment field.

At present, the output from our billing operations is retained and used as input for accounts receivable and sales-analysis reports. The output from our payroll, accounts payable, accounts receivable, and permanent property operations is in a form suitable to become the input to the general ledger system when it is completed later this year.

As to our organization, the manager of the Data Processing Center reports to the corporate controller and has the over-all responsibility for the private wire network, all centralized applications on the computer, the conversion of present noncentralized applications, and the installation and removal of all computer and EAM equipment in the operating divisions. All requests for additional accounting machines in any Sylvania location must have his approval. It is not difficult to get this approval if the proposed use of the equipment fits in with the over-all plan. Without such

authority, no company-wide record-keeping program could be effective.

The Manager is assisted by a Coordinator of Data Processing Planning, who makes recommendations for intermediate and long-range plans concerning the conversion of data-processing applications to a computer; a Manager of Applications, who directs the system-analysis and programming groups and is responsible for installing new applications and revising present applications; a Manager of Communications, who is responsible for operating the present private wire system and revising it to meet future requirements; a Manager of Computer Operations, who is responsible for the operations of the computer and EAM equipments and the scheduling of production to meet the time requirements of our "customers."

The few sentences I have used to describe the duties and responsibilities of my staff in no way convey the headaches involved in carrying out these functions, of which I am sure most of you are fully aware. In addition, the Manager, through his Office Manager, is responsible for the administration of the Data Processing Center, as well as community relations and personnel relations.

A significant factor deterring the use of large-scale computers on a centralized basis and, to a lesser degree, against computers on any basis, is the high cost of programming and the length of time between the start of defining an application and its successful operation on the production line. Within a relatively short time, however, since the first major business program was written (1953), significant improvements have been made. First was the adoption of mnemonic machine language codes. Even with this, every detailed business procedure still had to be translated into the more detailed machine procedure. Next, it was recognized that standard routines could be used regardless of the application. It also was recognized that the sorting and merging routine written once, at a cost of four to ten man-months, could be reused with less than a day spent in altering them to fit the new requirements. The next step was a library of commonly used routines, usually input-output and rerun, which further reduced time from several days to several minutes per run. The development of the first English programming language further reduced the cost of programming in that one

statement could take the place of three to one hundred or more machine language steps. This approach has resulted in the Common Business Oriented Language, COBOL for short, which can be used by less-skilled personnel in developing new applications, and because it will be common, we hope, to the computers of all manufacturers and will allow us to switch from one computer to another with less reprogramming investment. Despite all of these reductions in time and cost, programming will remain a bottleneck until a computer has been designed which is able to take a definition of the problem instead of procedural commands.

In the past and to a lesser degree to date, we have had difficulty in meeting target dates and projected costs of programming new applications. This deficiency is partially attributable to the operational personnel, who at the beginning are not fully aware of the capabilities of present-day computers and who, as they become more cognizant during the programming operation, request additional or improved output reports. Adequate planning and the determination to stick to the plan, even if it becomes evident at a later date that it is not the optimum, are essential if programming target dates are to be met.

As to the near future at the Sylvania Data Processing Center, as I mentioned earlier, we are planning to program our permanent property and general ledger record keeping to the computer this year. Also, we are giving a serious look into the efficiency of those applications we now have on the computer. Our payroll applications are between one and two years old. All of these were prepared when the art of programming was less sophisticated and our programmers less experienced than they are today. Like other computer users, we perform continual maintenance on all programs, but there always comes a day when a program just will not take any more patches, so we are conducting a study to determine the extent to which we should reprogram these applications either for our present equipment or for the equipment we will soon require to meet our data-processing needs. As in all large corporations, there are more applications suited for a computer than can be programmed within a reasonable time by a central group in an efficient and orderly fashion.

To assist us in taking full advantage of the present stage of com-

puter development and programming, we are installing medium-size computers in two of our divisions to perform the billing, inventory control, and warehouse-replenishment functions. As the art of programming and communication facilities improve so as to reduce the cost of processing data at a central point, it is probable that many applications which can now be converted faster on a local basis will be transferred to a central computer. We do not plan to have our operational procedures adapted to meet data-processing requirements to any degree. We realize we are engaged in many different businesses, each with its own pecularities and each requiring, in some instances, different information to run the business properly. Whenever we can make uniform the function for the whole corporation, we are sure we can perform data processing on a centralized basis at a lower cost.

Automation in the office is becoming just as vital a tool to the industry as automation in the manufacturing plant. Since the very essence of our free enterprise is intense competition, it stands to reason that an organization must move rapidly, thoroughly, and effectively to take advantage of the data-processing opportunities available to it, or it will fall by the wayside.

Lieutenant Colonel Orville L. Smiley

Weapon-System Logistics Management in the Missile Age

As missiles come to supersede conventional weapons, logistics management must be changed to keep pace. Because of the complex nature of the new weapons systems, managers are faced with never-before-encountered problems of control. The Air Force has developed a weapons-system concept of management in which responsibility and control are established on a world-wide basis for a particular class of weapon, including the air vehicle, related equipment, supporting facilities, and personnel necessary for combat operations. The heart of such a system is the electronic data-processing center in which is developed central knowledge of logistics conditions and actions throughout the world.

Colonel Smiley is Chief, Systems Integration Office, Advanced Systems Development Division, Air Matériel Command, USAF.

THE age of missiles is intriguing to most of us no matter what our calling may be. Perhaps this is true because of the exciting new vistas for personal and scientific discovery the missile opens to our mind's eye. For example, the transportation specialist sees the future earthbound commuter using the twenty-minute Paris to New York shuttle, while the sociologist, on the other hand, prognosticates the probably large shifts in world population and the playboy sees the new moon discovery, Sea of Dreams, with its

spectacular lunar sports as the next weekend excitement for the international set, no doubt soon to be renamed the interplanetary set. From the military viewpoint, one can foresee the requirement to prevent the immediate space surrounding the earth from being used for aggression. This new battle arena suggests a strange new arsenal of space weapons with their attendant new military tactics for deployment and their new logistic methods for support. Already the arsenal is being built and the intercontinental ballistic missile is rapidly becoming a primary force in the defense of our nation and the free world. This new and deadly weapon has married the ballistic missile with a nuclear warhead, and now incredible devastation can be delivered across intercontinental range at supersonic speeds. But while this new family of weapons may be the military tacticians dream weapons, they are also the military managers' nightmare. They pose many new and complex control problems.

I propose to tell you something about the work the Air Force has done to streamline its management to support more effectively these advanced weapon systems, and I have arranged my presentation first to outline briefly the rapidly changing nature of modern defense and weaponry that has led to a new, highly responsive management control system known as "Weapon-System Management." Secondly, I will briefly explain what this type of management is and some of the basic functions involved. Thirdly, I will tell you a bit about the extensive logistic systems research, planning, and operations using electronic data-processing equipment (EDPE) being conducted by the Air Force in support of missiles and other advanced weapons. And, lastly, I will draw a few personal conclusions based on my work in developing advanced logistic systems for computers.

To understand better some of the complex problems that a management system for modern weapons must consider, let us briefly review some of the characteristics of these weapons and the general concepts they lead to.

1. The cost of the complete new weapon system is rapidly increasing to the point where the gross national product can no longer support the concepts of abundance and stockpiling.

2. The complexity is greatly increasing with each new technological breakthrough. This is particularly so with reference to the

ground operational equipment required in support of the air vehicle.

3. Each new complete weapon system is more sophisticated than the last. It requires more and more critical, highly specialized, and diverse types of people working as a closely knit team to develop, produce, and operate it.

4. The rate of obsolescence is rapidly increasing because new technological advances are occurring more frequently in our better-educated age of science and discovery. Delivery systems often become obsolete while still in the conceptual stage.

5. The destruction potential of the single weapon has greatly increased (an air vehicle can now carry more destructive power than all the air forces of World War II).

6. At the same time the quantity of weapons required to create almost total destruction has reduced, but the quality must be much better because of the requirement for a very high degree of reliability and readiness.

7. Because of the high kill rate of modern weapons and the greatly increased speeds of delivery, the time to prosecute the decisive stage of a modern, full-scale war has greatly reduced.

8. And, lastly, the time to prepare for major conflict has rapidly decreased. This time was once measured in years; later it was months; now it is minutes. Soon there will be no practical delay and buttons may push themselves. In fact, the parry and thrust of future wars may well be decided by sophisticated computers using equally sophisticated control systems. However, the ultimate decision to strike in anger will always be the decision of man.

I think the nature of modern weapons and their probable use will lead us to the conclusion that time is perhaps the most critical commodity of our age. Since time for preparedness may now be measured in minutes, an effective retaliatory force in being is required. Should a major surprise attack occur, what we do not have in a ready state may never be used. This means that our military logistics must be geared to support what is essentially a wartime force within the framework of a peacetime economy. One way of buying this critical time is to use a modern, streamlined method of management.

Such a technique is the system used by the Air Force to conceive

and create a new combat force, for placing it in the field and for logistically supporting it throughout its life cycle. This technique is called weapon-system management. It started in 1953 as an official concept only, and is now, in practice, a vital management system. It might be considered a form of product management, the concept of which is not new. Many American businesses have recently reorganized along product lines. For example, the traditional, functional managers of research and engineering, production and merchandising were autonomous at one time. Now, within a product-oriented company, we may find a vice president in charge of a particular product who fully manages the development, production, and sales activities for his product. In the Air Force, the end product is an effective, in-being weapon system, at the right place, at the right time, in the right quantities, and delivered at the least possible cost. A weapon system is officially defined as an air vehicle together with all the related equipment, both airborne and ground based, the skills necessary to operate the equipment, and the supporting facilities and services required to enable the instrument of combat to be a single unit of striking power in its operational environment.

Very simply stated, a complete weapon system in its operational environment is a combat-ready missile squadron based somewhere in the world. The missile itself is known as the air vehicle. Surrounding it are the additional primary ingredients. They are the operational facilities such as the blockhouse, the generating plant, and other general real estate; the ground-support equipment such as the ground-guidance equipment and launch cranes; the operating personnel, their skills, techniques, and associated training; and the supply and maintenance activities necessary to keep the air vehicle in a ready state.

Now consider the primary actions in conceiving, producing, and delivering a new ballistic missile under Weapon-System Management. In order to insure a complete integration of all the facets of the new weapon system, the Air Force draws together a joint Industry–Air Force Team. The members of the team are specifically designated and given clearly defined responsibilities. They manage the weapon system from the cradle to the grave. One team member is given the responsibility for Executive Control, called

EMR or Executive Management Responsibility; that is, he is the general manager and has final responsibility to see that the management objectives are met. This permits responsibility to be fixed. In fact, we can now find the man who can be sent to Congress to stand up and say "I goofed." The primary Air Force team members are: (1) the Air Research and Development Command, who is assigned technical supervision for the weapon system from the design study through the combat strike (this command has EMR during the research, development, and test phases); (2) the Air Matériel Command, who is responsible to procure and logistically support the weapon system (once the weapon has been tested for operational suitability, the primary logistics responsibilities of procurement, production, and installation become paramount, and Executive Management responsibility is turned over to the Air Matériel Command at this point); (3) the Air Training Command, who technically trains the required operating personnel; and (4) the operational command, such as the Strategic Air Command, who operates the weapon system in its combat environment. The industry member of the team is the prime and associate weapon-system contractor who develops, produces, installs, and checks out the hardware as a complete and operating system to meet Air Force specifications.

Once operational, the Air Matériel Command logistically supports the weapon system until it is retired from the Air Force inventory. This is accomplished by assigning the prime management responsibility to the commander of one of its subcommands, called an Air Matériel Area, who is oriented to the world-wide logistical requirements of the in-being system. He acts as the Air Force executive agent during the remainder of its life cycle and essentially is the Air Force Weapon-System Manager. He must evaluate such things as how well the system is performing, its reliability, and the necessity for modifications. He determines the item and dollar requirements and directs the receipt, issue, and movement of all vital supplies, called direct-mission items, that could render the system ineffective if not on hand at the missile site when required.

So much for what Weapon-System Management is and generally how it functions. I would now like to relate some of the EDPE

systems research and development work going on in the Air Force to assist the Weapon System Manager to support logistically his weapon in an optimum manner.

Early in 1956, as a result of the ballistic missile planning, the Air Force recognized a major opportunity to develop a new, highly automated, integrated support system which would embody new advanced concepts and the latest principles of weapon-system management. Since the system was being developed to support the new tactical concepts associated with the first intercontinental ballistic missile, the Atlas, and since the ICBM would not be operational for over two years, it could be developed in a rather uninhibited way. That is, a wide choice of possible systems and techniques could be employed. The advanced support concepts that logistics planners had believed in for years, many of which were in violent opposition, could now be explored and weighed for possible use. The primary management considerations for making this new system possible were the bringing together of a group of highly skilled systems engineers under the Air Matériel Command, and the authorization that they integrate and automate the information-flow system to the highest practicable degree, using the latest electronic data-processing and advanced communications equipment then available. It was recognized that such a system would be very costly to develop, but, should it prove successful for support of the first ICBM system, Air Force operational effectiveness would be tremendously enhanced. Also, if the system were sufficiently generalized, it could be amortized by using it as the standard logistics system to support the advanced weapon systems of the immediate future. It was recognized early that probably it would be too expensive to go back and recapture the data necessary to trigger such a system for support of conventional weapons. This later proved to be true. To do this development work, the Air Matériel Command carefully selected a small group of Air Force military, Civil Service, and Civilian Management consultant personnel and placed them under a single head in the environment of the San Bernardino Air Matériel Area at San Bernardino, California, where the Atlas, Titan, and Thor ballistic missile systems were assigned for Weapon-System Management and where executive management would finally rest. In the group were logisticians,

highly skilled in Air Force supply, maintenance, procurement, transportation, and comptroller functions, to research and develop the specifications for the new support systems. Also, there were EDP specialists, skilled in computer programming and operation, and smaller numbers of communications and data-processing-equipment engineers to select and assist in installing the required large-scale EDP and advanced communications equipment, as well as other carefully selected, skilled professionals such as mathematicians and accountants, all of whom were made a vital part of the research and development team. Incidentally, it was recognized early that a representative of the Air Force Auditor General's Office should be present during the development of the system to accomplish a procedural audit prior to programming, since the costs associated with reprogramming a highly automated system to insert additional internal audit trails and controls after the fact would be prohibitive. I will tell you more about the work being done in this area later.

I will now briefly describe what the system developed by the group turned out to be and something of its size and complexity. The ballistic missile planning had called for a highly responsive logistic system having reflex characteristics. The basic concepts that evolved are discussed below.

1. Centralized knowledge of assets. This was to say that to provide a highly responsive support system, the Weapon-System Manager had to have at his finger tips the complete world-wide logistic status for his weapon. Such things as the location and condition of all vital supplies that could ground the missile were of paramount importance. These were called direct mission supplies, and all significant actions pertaining to them would be noted centrally. Housekeeping items did not deserve this kind of treatment and would be excluded from this advanced system and handled under conventional procedures.

2. Data processing. Only through the use of high-speed, electronic data-processing equipment could up-to-date centralized knowledge of assets and reflex logistics be attained.

3. Automatic resupply. If the weapon system was to be held in constant readiness, it had to be completely supported, stocked with normal operational spares, continuously with a zero out-of-com-

mission objective. This was to be accomplished through electronic data-processing programs designed to relate spares consumption to levels and automatically to ship when levels reached resupply points. When dealing with the time-delay factors associated with ballistic missiles, a pressure, rather than a suction, supply system was required.

4. Minimum administration at operational level. The business of the ballistic missile squadron in the combat environment is to maintain a constant state of readiness. It was not to be burdened with details of stock record accounts, reordering, and so forth. The electronic data-processing equipment would centralize all record keeping and relieve the squadron of these details.

5. Rapid communications. A responsive logistic system using EDPE would be largely ineffective without rapid communications. Therefore, all squadrons, contractors, and storage sites were to be directly connected with the Data Processing Center by transceiver and teletype channels.

6. Air transportation. The movement of replenishment spares must be tuned to all other phases of this highly responsive, rapid, and reliable logistic support system. Hence, air movement would be used to the optimum.

7. Source to user. This says it is faster to ship directly to the squadron from the source, whether from an Air Force depot, where it may be a stocked item, or from a contractor production facility.

8. Maximum maintenance at site. Movement of major items of equipment is both costly and time consuming. It also requires costly inventories because of lengthened pipelines. Therefore, all maintenance possible would be conducted at the squadron location.

These were the basic criteria from which were molded the advanced integrated systems to support and keep our big sticks in a maximum ready state. We had thus recognized new objectives.

These concepts have been put together into an integrated, automated information system. The Electronic Data Processing Center is the hub of information flow. Here central knowledge of the latest logistics conditions and actions on a world-wide basis are maintained. These are such things as assets required and available at all locations, rates of failure, repair status, and future program. With central knowledge of serviceable assets on hand and due in,

automatic resupply from any available point in the system can be affected without human intervention as usage occurs. All actions associated with data flow from receipt of the usage report at the Center to receipt of matériel in the field can be automatically processed.

From the EDPC a rapid communications link connects the Air Force Depots, where common items of supply are centrally procured, to the weapon-system storage site, where these items are stored as back-up stocks to the squadrons. Also, a link connects the contractor's production, repair, and storage site facilities, where items of supply peculiar to the weapon system are sometimes stored and repaired. These items are procured in minimum quantities and are usually moved direct from the contractor's facilities to the squadrons in the early stages of weapon-system development. This leads to short pipelines and to source-to-user and airlift concepts. All squadrons are also connected with the EDPC to report the latest logistics actions and conditions. These then are the basic ingredients of the automatic portion of the system. The system can lie inert until triggered by information from any one of these input sources, at which time it will automatically react. Only system-out-of-balance conditions and periodic reporting of status is made from the EDPC to the weapons-system manager. The manager's decisions and actions on these exception-type conditions are reported back to the EDPC as another form of input to relieve an out-of-balance condition, or he will continue to receive notification.

A more detailed view of the integrated EDP system is shown in Exhibit 1. The circles on this diagram represent a series of internal and external files maintained at the EDPC. They are the files that, if kept current, represent the basic information for centralized logistics knowledge and automatic processing. They are such files as Technical Data, where all the fixed indicative data concerning the characteristics of a line item of supply are maintained. The additional subsystem files are Inventory Control, Transportation and Shipment Control, Procurement Status, Weapon System Configuration, Program Preparation, the Computation of Stock Levels, Factors and Requirements, Technical Failures, Cataloging, and Monetary Inventory Accounting.

Note in Exhibit 1 the primary data origination points on the left,

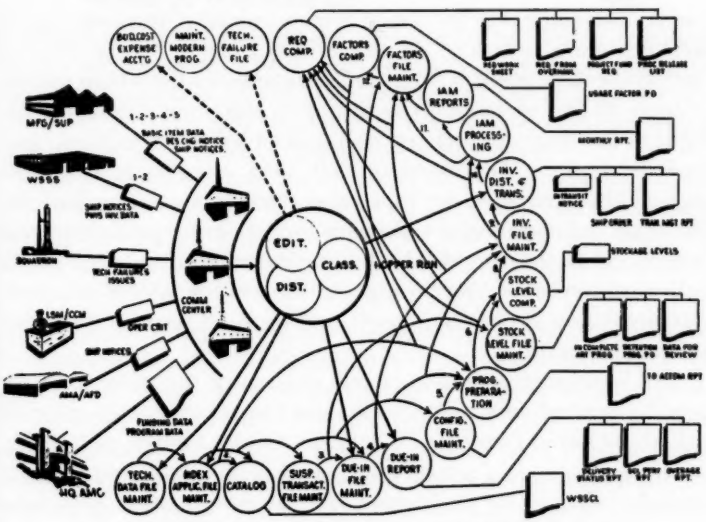

Exhibit 1. Diagram of an integrated EDP system

such as the contractor and Air Force storage sites and the sqaudron. The transaction data from these points is dispatched by teletype and transceiver to a communications center located adjacent to the EDP. From here it goes in card or magnetic tape form to the EDPC for machine processing. The large center circle represents a hopper. I think this concept is a major forward step for truly integrating large subsystems economically. A single element of information submitted from any source enters the hopper where it is edited as valid information, classified as to type of data and distributed automatically to all the system files that may be affected by it, as represented by the black arrows from the hopper. This permits all files to be compatible and current.

The small black arrows on the diagram represent the interaction and data flow between files. During the systems-research phase, the processes to be accomplished in each subsystem were allocated, and an input/output matrix of data elements was agreed upon and furnished the analysts and programmers assigned the individual subsystems. Once these elements were agreed to, a nearly absolute freeze of processes and data elements was declared. I

cannot overemphasize the use of this technique if you ever expect to check out a system of this size without major reprogramming during the debugging, testing, and simulation of the whole system.

Some of the exception-type printouts made are shown on the right of the diagram, such as system-out-of-balance conditions and periodic reports. To review quickly then, the system has these desired characteristics: (*a*) rapid and error free communications, (*b*) single-point entry and validation of data against predetermined criteria, (*c*) changes to all files by single notification, (*d*) standard data elements in all files throughout the weapon system, (*e*) accurate prediction of changing needs, and (*f*) rapid response for management decision.

The integrated operation of one portion of the system was recently described very aptly by General Coupland, Commander of the Air Matériel Command's Ballistic Missile Center, as follows:

Let's suppose that a missile count-down is in progress. Suddenly a red light flashes in the blockhouse. The count-down stops, technicians discover that a new part is needed within the missile system. A hurry-up call goes from the control room in the block house to the strategic missile squadron supply. An expediting officer takes over for the part requirements. He passes the word to the stockroom. Here, only minutes away from the waiting missile on the launching pad, are the spare parts, provisioned and kept up to predetermined stock levels, serialized for compatibility with the configuration of the weapon system they support. These are keys to operational readiness. Only by maintaining an inviolate level can each missile squadron be self-sufficient and independent of enemy action or technical breakdowns. The part so urgently needed is located by bin or shelf number. Already packaged for shipment, it is quickly checked out and delivered to the waiting "expedite" vehicle, kept always standing by for the short run to the launching pad. The average time for malfunction to delivery of the new part is 30 minutes—with a maximum allowable time of 60 minutes.

Next, a skilled operator reproduces all fixed data from a master card and key punches such variable data as required—such one-time facts as time, place, and circumstances transcribed from the pencilled worksheets. Every detail of parts issued to the launching site for field maintenance, the inspection reports on the failed part, the repair action which is thus generated, and the fact, time, and the method of shipment from squadron direct to the repair depot is reported.

These carefully registered holes represent the interaction of human beings and hardware. At this point, the basic input goes forward by transceiver and teletype from the squadron at Vandenberg, or Cheyenne or wherever it may be located, to the Electronic Data Processing Center that supports the Weapon System Manager.

The key-punched cards are fed into a card-to-tape converter. Once transaction information is on tape at the EDP Center, electronic data processing proceeds under program control in the usual way. Stock levels are checked and, when required, automatic resupply to the squadron is effected—all this in a matter of minutes.

The EDP programs General Coupland referred to are highly integrated and vary from simple to very complex. One of the features of a high degree of integration is the possibility for generating many actions from a single-transaction entry. For example, in the resupply segment of the integrated system, a usage report from the squadron triggers the action to check automatically the squadron levels to determine if the resupply point has been reached; if so, the storage site levels are examined to determine availability, and if these levels are sufficient a shipping order is made to resupply the squadron to its stockage objective; tables are then examined, and the most suitable transportation mode and shipping schedule is selected. The order is punched in card format and sent to the storage site by transceiver. The squadron is simultaneously notified of the impending shipment. The follow-on actions of transaction suspensing, material in transit control, and receipt acknowledgement from the squadron are processed automatically and without human intervention. In this case had more critical squadron levels and warehouse balances been reached, the process would have been more complicated. These decisions are based on multiple tables and priorities, and many additional actions such as automatic shipment of interchangeable and substitute items are made. A feature of the automatic action resupply system is the numerous warnings provided the Weapon-System Manager of his impending shortages as various critical levels are reached. These notices of an out-of-balance condition also automatically provide the manager with the data on which to base his decision. He regularly faces a decision on such multiple courses of action as: Should emergency funds be requested and emergency procurements be made because of unexpected high rates of usage,

or should redistribution be made or possibly additional repair facilities be established? All subsystems are mutually supporting and data flows from one subsystem to another in an automatic cross feed following the closed loop principle with feedback. For example, high usage rates experienced in inventory automatically feeds to the stock-levels subsystem, which, in turn, automatically establishes new levels in inventory. In this way, literally thousands of actions that could never be accomplished or, for that matter, that we were not even aware of until too late, can now be accomplished in a timely manner.

Next, I promised you a look at what the Air Force Auditor General is doing as a part of the advanced-systems development effort. Thanks to the foresight and pioneering efforts of your Second Vice-President, Mr. Schuetz, and Mr. Orin Row of the Air Force Auditor General's Office present here today, we have had an auditor attached to the Advanced Systems Development Office for about two years in a liaison capacity. He has accomplished a procedural audit on each subsystem as it developed and has offered advice on the propriety of the audit trail and the system of internal controls. At this time, he is completing a final procedural audit of subsystems and plans to write the final audit instructions for use of resident auditors at all advanced-systems locations.

External audits do not appear to pose a problem, but I would defy the uninitiated internal auditor to write a suitable audit program for this system in less than one year. And I would consider the highly skilled auditor, as a consultant, an absolute necessity when undertaking the development of a system of this size and complexity.

The system shown on the previous diagram was completed in two phases. Phase 1 was called IOC-I (initial operational capability system I). It was developed to provide back-up support to the ICBM, if required, and to prove some of the techniques of integration being employed during phase II. It was completed July 1, 1958. Phase 2 was called IOC-II and included the full-scale group of subsystems I have previously outlined. IOC-II was programmed, debugged, and simulated in early 1959, and was placed in operation on June 28 of that year in full support of the Atlas weapon system. On August 15, it was applied in initial support of the Titan missile, and on January 1, 1960, it was placed in support of the

Thor. It has been officially approved as the Air Force Standard Logistics System for Advanced Weapons and will go through an extensive operational shakedown period until July 1 of this year. At that time it will be applied in support of the other advanced weapon systems as they phase in, such as Samos, BMEWS, and Minuteman. Improvements are being made on a controlled basis. I might say we have made our share of mistakes, and these will be corrected in IOC-III, which is now in the planning stage. IOC-II is currently programmed for the IBM 705 Model II, and we are in the process of reprogramming it for the Sperry-Rand 1105 and possibly for other equipment as necessary. Our command objective is to insure that whatever hardware is used, the system input, output, and internal logic will be adhered to. One word about the ballistic missile communications net. The equipment placed at the outlying terminal points consists of a key punch, a teletype, and a transceiver connected by commercial lines with matching teletypes and transceivers located at the combined communications and EDP Center. Advanced automatic communications equipment will soon be installed in place of the conventional teletypes and transceivers at the Center supporting the Atlas, Titan, and Thor weapons. This will occur on April 15, 1961. This new system features tape-to-tape high-speed transmission and automatic information routing, reformating, and some validation which should greatly cut down the manual handling problems associated with data preparation for EDPC and streamline the gross-error detection and correction procedures.

In the space remaining, I will list some of the personal conclusions I have drawn concerning electronic data-processing systems. These conclusions are general in nature and are in no particular order.

1. Missile hardware development is an excellent physical analog of EDP systems development. They both have distinct research, development, test, and shakedown periods before they are fully operational. Also, the more integrated and properly sophisticated they are, the greater the cost, the longer the development and shakedown periods, and the harder they are to change; but the return in achievements is significantly greater. Obviously, a balance in these factors is required.

2. I next conclude that the communications link between the

policy maker and the machine is urgently in need of improvement. The early development of fully automatic programming techniques, as opposed to automatic coding, appears to be the answer.

3. Better techniques to assist the systems analyst are necessary. We have spent much time in automatic coding systems to help the programmer, but little assistance has been given to the analyst, who applies 80 per cent of the effort on new systems.

4. In regard to systems research, the emphasis on hardware has frequently camouflaged the really big work of new systems research and development we have to accomplish. Good systems engineering is a prerequisite to effective automation.

5. Basic systems analysis should always be accomplished without regard to hardware. If this is done, the product will be better oriented to the over-all management objectives. The best processing method can then be selected, based on the desired degree of system response and the hardware available. This is perhaps the hardest analytical habit to break, particularly if you are well versed in both systems research and equipment-processing methods.

6. A great deal of work in new operations research techniques must be applied to solve some of our more difficult management problems. Many of the present highly touted mathematical models work well in the theoretical environment, but are not sufficiently developed to cope with the real-world situation.

7. Some Air Force processes appear to have a close corollary in business. For example, the traditional functions of ordering, supplying, accounting, storing, and shipping are essentially the same. Only methods differ, based on such factors as different time delays, costs of stock-outs, and need for response. My studies of these processes in a generalized sense indicate that the item world and the financial world are greatly different and have different objectives. Too, that the physical possession and handling of items can be separated from the planning, controlling and accounting functions, thus permitting management and associated EDP control systems to be centralized and physically separated from the scene of operations.

8. We constantly seek to recruit people with combined outstanding systems-analysis and programming talents. This is the ideal combination, but they are extremely scarce, and we prob-

ably are doomed to continue to have the two separate types in our development work.

9. We are a minimum of three to five years behind the capabilities of the present family of computers with regard to an understanding of how to use them effectively, and already the so-called second generation of computers is being announced. We may not catch up, but I fervently hope that the second generation is smarter and does not have the moronic tendencies of the first.

10. Top management must recognize the advantages and disadvantages of highly integrated EDP systems. If such systems are desired, management must provide the proper administrative framework for successfully developing and implementing them. The minimum constraints are to: *(a)* provide long-range planning and lead time for development, *(b)* establish a centralized systems-change control board at a very high level, and *(c)* ensure strict adherence to the approved system by all users.

In conclusion I would say that as a technological breakthrough, electronic digital computation ranks with the splitting of the atom in its ultimate effect on our society. The active role of leadership the Federal Government Accountants Association is taking, as displayed at this symposium, to guide your society in better using this powerful new tool will thereby add many additional successes to your already rich professional heritage. I hope my showing you some of the latest Air Force management methods and techniques will be of some value in your further deliberations.

W. P. Turpin and *C. D. Bean*

Automatic Data Processing in the General Services Administration

The installation of automatic data-processing equipment is perhaps the most challenging problem which has yet come before administrators insofar as statistics and record keeping are concerned. In order that the vast potential of electronic computing equipment can be efficiently developed and utilized, careful plans must be laid for every step involved in the installation. In the first part of this paper Mr. Turpin describes the preliminary work undertaken by GSA in evaluating the capabilities of ADP in light of the agency's long- and short-run requirements. The second portion of this paper is devoted to a description by Mr. Bean of the application of ADP to the operations of the Federal Supply Service.

Mr. Turpin is Comptroller, General Services Administration, and Mr. Bean is Commissioner, Federal Supply Service.

PLANNING AND DEVELOPMENT OF AUTOMATIC DATA PROCESSING

GSA has been planning and studying the potential for automatic data processing in its many business-type operations since 1955. It was imperative that the capabilities of this new management tool be evaluated from the standpoint of the existing requirements of the agency as well as the long-range needs. To accomplish this the Administrator established a GSA Electronics Committee in 1955.

The Electronics Committee was composed of seven top-level executives, one from each of the GSA operating services and from two staff offices. Their specific task was to identify the areas in GSA where ADP applications could be most fruitful, to inform the Administrator of their findings, and to recommend appropriate action. The possible users of ADP that the committee considered were:

1. The Federal Supply Service involving *(a)* warehousing and distribution of common-use items of supply, *(b)* national buying, *(c)* motor vehicle operations, and *(d)* excess property utilization and disposal of surplus.

2. The Public Buildings Service with responsibility for *(a)* operation of buildings, *(b)* space management, *(c)* repair and improvement of buildings, and *(d)* telecommunications (telephone and teletype).

3. The Central Office staff with the problems of *(a)* budget and allotment accounting, *(b)* personnel management and payroll, and *(c)* general accounting.

4. The Transportation and Public Utilities Service daily processing requests for *(a)* freight rates and routings, and *(b)* freight traffic analysis, rate appeals, and the like.

5. The Defense Materials Service responsible for administering and maintaining tremendous stock piles of critical and strategic materials.

These users represent a sizeable work and service responsibility. What the committee learned of the accomplishments of industry and government in the use of ADP led them to conclude that this new technology could relieve GSA of massive paper-work problems in the majority of its operating programs.

In September 1957, the Electronics Committee recommended that the most fruitful area for the first ADP application in GSA was the Federal Supply Service Stores Operations. Based on the committee recommendation a feasibility study team, composed of fourteen analysts, with equal representation from the Federal Supply Service and the Office of the Comptroller, was organized at this time (1957). Thus there was joint membership from the Staff Organization administering Data Processing and the Operating Service directly concerned. The objective was to investigate

and study thoroughly the Federal Supply Service Stores operations.

The joint team first surveyed the data-processing problems of the Federal Supply Service at the regional level, determined other management needs in both the Regional and Central Office, and then evaluated operational ADP systems in other government agencies and private industry. Secondly, it set to work to develop a new system designed specifically to meet the problems and needs of Federal Supply operations. In June 1958 it decided that the three elements of the Federal Supply problem, namely Stores Operations, Inventory Management, and the Related Financial Accounting, could be completely integrated in a single ADP system using a medium-scale computer.

At this point in time developments in the field indicated that the electric accounting machines, in use since 1952, would soon be inadequate for the data-processing work load. By 1959 the volume of Stores depot supply business had virtually doubled and continues to increase at a rapid rate. There has been a corresponding increase in the paper work. Obviously, mechanized equipment had to be operated at peak or overload capacity. These were the causes for considering equipment with greater capacity. Expanding the staff and increasing the existing equipment would not have produced the desired results. GSA needed more modern equipment to do the job that had to be done.

It was apparent that immediate steps had to be taken on a short-range basis, because of the time still required to develop an optimum ADP program on medium-scale equipment. It was decided in July 1958 to install a small-scale computer in the Kansas City Regional Office. The equipment selected was chosen because it (1) met the immediate requirements and (2) necessitated a minimum redesign of the existing system. A small group of analysts was detailed to lay out a system, program it, and convert to the new equipment. Six months later, in December 1958, the program was fully operational. The success of this first installation in reducing processing time and improving processing services encouraged similar installations in other GSA regions where mechanical equipment was being overtaxed. By June 1960 small-scale computers will be operational in Kansas City, Atlanta, Dallas, and San Francisco. Four other regions are under consideration for

identical action. However, current studies of the most modern ADP technology and the operating problems of GSA may lead to significant early revisions in systems-design and equipment requirements.

The long-range plan for ADP in the agency is based on the present best estimates of future needs and calls for one or more medium-scale computers. The Central Office ADP team working on this project produced and published specifications in January 1959, which described the peculiar requirements of the Federal Supply Service Stores Operations and integrated the three phases involved, i.e., order processing, inventory management, and the related financial accounting. These specifications provided the basis for manufacturers to submit their equipment proposals. The manufacturers, the National Bureau of Standards, and interested organizations in industry praised the excellence of system concept and the unusual degree of integration achieved by the team.

The specifications were submitted to twenty-one manufacturers soliciting equipment proposals to process the system. For the purpose of promoting common understanding the team conducted a symposium for all interested manufacturers and explained the elements that had been integrated and the general system concept. In addition the ADP team was available for consultation to enlarge upon or amplify the specifications as requested. Seven manufacturers responded to the invitation and submitted proposals. The real task of evaluation then began. The proposal analysis consisted of the following: (1) determining compliance with the specifications, (2) validating manufacturers claims for equipment performance, and (3) recommending the equipment to meet the needs of GSA. Management decided to give the National Bureau of Standards a contract to perform the desired analysis. It was felt this action best served the interests of both the manufacturers and GSA. In December 1959, NBS submitted their final report, and a month later GSA accepted their recommendation and issued a letter of intent to the Radio Corporation of America for delivery of a medium-scale computer in Washington, D.C., by February 1961.

The Federal Supply Service operation at the Washington depot will be the first application on the new system. It is estimated that

about 90 per cent of the prime shift time will be required to process the work load. This leaves the balance of the prime shift plus a second and third shift for other applications with little increase in equipment costs. In the calendar year 1960 the entire effort will be directed toward preparation for the scheduled delivery of the equipment. At the time of the delivery the system will have been thoroughly checked and ready for computer processing. Experience of others has proved that no system, particularly one as complex as this can be expected to be without minor flaws at the outset. Therefore, a shakedown period of two or three months is contemplated so that any unexpected problems can be resolved, and by May 1961 the program will be operational.

It is estimated that the first application will realize both tangible and intangible savings. As other computer applications are programmed, further savings will accrue. Savings of any nature are hard to come by in GSA or any organization. This is especially true in the case of automatic data processing. Without top management support savings are virtually impossible. An ADP program must be supported intelligently at all levels of responsibility. Management should make clear the need for the system and the fact that it can save time and money as well as yield more accurate information. Objections can always be found as to why any new system will not work. Clear thinking, sound planning, and decisive management action are the spark plugs necessary to do the job and to ensure that an improved system will work.

The initial GSA program, in terms of predelivery preparation, requires 751 man-months. This is equivalent to eighteen persons working full time for a period of three and one-half years. The scope of the necessary preparations is fantastic to the uninitiated. The magnitude of the effort required by the personnel directly concerned with the project planning and preparation has already been expressed. It is also necessary to prepare executives and line personnel for the transition to complete automatic data processing. In addition the analysts and programmers must be trained in computer know-how and operation. It is a new language and a new method of doing business. In all, the GSA training schedule calls for a minimum of 11,554 hours of instruction

involving 444 people. The task of converting to full automatic data processing should not be underestimated. This is an area not always made clear to prospective users of such equipment.

Experts advise that development costs preceding installation and operation of a computer are generally expected to equal 50 per cent of the cost of the equipment. The GSA medium-scale computer purchase price is approximately $850,000; therefore the development cost should be in the neighborhood of $425,000. Experience indicates this yardstick estimate is a good measure.

Study and consideration is being given other computer applications in the immediate future so that the full capacity and the paid time still available on the equipment can be utilized. The more important applications include: *(a)* building management, with annual expenditures totaling $190,000,000 involving some 13,000 customer space assignments, *(b)* building repair and improvement, with annual expenditures of $85,000,000 to maintain 4,900 buildings, *(c)* strategic stock pile, valued at $9 billion dispersed in 215 storage locations throughout the continental United States with a total of approximately 100 billion pounds of raw materials, (*d*) accounting, involving 400 separate accounting records, (*e*) personnel management and payroll, involving 13,000 employees, and (*f*) the national buying function, which involves central contracting for supplies and services.

The situation before ADP in most organizations is usually one where a number of systems have been developed as a result of normal growth. In most cases they are not completely compatible one with the other, yet data must be assembled from each to compile the required management reports. This can be very difficult when reconciliation and deadlines are involved. When the data is finally assembled, it may be historical rather than current. On the other hand, after ADP it is felt that the what, when, where, how, why, and so forth is as available to management as the nearest telephone. The system provides the information needed, and action or decisions can be predicated on the existing facts immediately available. Government and industry agree that a good data-management plan includes defining objectives, basic training, accurate analysis, programming, operations training, pilot opera-

tions, conversion, and full-scale operations. These are the steps which GSA is following in preparation for a medium-scale computer installation in Washington, D.C.

APPLICATION OF AUTOMATIC DATA PROCESSING

As progress is made in the mechanization of paper work in Federal Supply Service operations, we learn and develop techniques for manipulating data to serve better our management needs. As work load increases and our knowledge expands, our desire to refine these techniques with better equipment is stimulated, and we look to more sophisticated methods and tools. The equipment selected and system proposed will provide the facilities to accomplish what we can predict as required in the foreseeable future for order processing, inventory management, and accounting. With climbing sales we must have the foresight to tackle this volume intelligently.

Why a medium-scale computer for the FSS operation? Improved efficiency as compared to other systems is the reason. Using the Kansas City region as an example, where a small-scale computer is in operation and they have used punched cards up to December 1958, it required 16 hours to handle the order-processing function under the punched-card system. Under the small-scale computer it requires only 4.5 hours, and under a medium-scale computer system we estimate it will require only a half-hour for the equivalent job. The reasons for these varying times is that under punched cards it required 166 individual steps in the order-processing function—that is, manual card handling for sorting and "off-line" operations—while under the small-scale computer there is a minimum requirement for manual card handling by the operator, and under the medium-scale computer there will be no operator card-handling steps in the processing involved. There is a greater efficiency under the medium-scale computer. Another comparison is: each punched card contains a maximum of 80 characters, the small-scale computer in Kansas City has a file capacity of 5 million characters, whereas one reel of tape for use with a medium-scale computer contains 6 million characters, and there is no limit to the number of reels that can be developed. Thus there is an unlimited file capacity for that type of system.

The equipment we plan to install in our Washington region has the capability to perform without human intervention many functions simultaneously with the same data. Basic data used originally in order-processing routines—quantity of stock on hand, for example—can be used in the programming of inventory-management functions. Similarly, purchase due in, the basic data for inventory management, is also used in order-processing runs. One tape record serves many purposes.

Part one of the integrated system is the processing of customer orders. Highlights of the automatic order processing with a medium-scale computer are as follows: *(a)* It checks stock availability and will order bin replenishment when necessary. *(b)* It creates and releases back orders and will control future orders by blocking stock at the appropriate time. (*c*) It produces item-selection tickets for specific location and will adjust the order to issue pack. *(d)* It prepares bills of lading when necessary and a consignee-address stencil as well. *(e)* It permits maintaining a perpetual inventory control by location and condition. And *(f)* it establishes operational controls and audit trails.

Here is an example of what can be done for the warehouse manager at the close of each day for tomorrow's business. The computer can produce in advance a production schedule reflecting: (1) the optimum work load for warehouse capability considering the staff on hand, (2) the proper distribution of orders between bin and bulk selection, (3) the division of orders in lots which would be the basis for controlling the movement of work through the selection area, the packing and assembling area, and finally the shipping area, (4) the consolidation of orders by shipping route for economies in transportation, and (5) the number of packages, the weight and cube of the orders on the production schedule, while at the same time accumulating these statistics for later use.

Part two of our integrated system is the management of inventories, which involves much paper and data processing. The nine manually maintained paper records—purchase-case file, due-in expedite card, short stock analysis, receiving reports, contracts, buy cards, level changes, back orders, and analysis of demand—will be converted to one magnetic tape record. By automating the control records for inventory management functions, more effective results

are obtained. The buyer is given better tools and he is relieved of tedious paper pushing. We have the automation potential to do the following by putting on tape the inventory management records and processing the daily transactions through the computer at the same time: Obtain buying information such as when to buy (based on the reorder point signal), where to buy (from the source record on tape), and how to buy (national contract or informal purchase). We can maintain a bidders list, thus replacing 50,000 address cards, and remove nonresponders after the third time. We can prepare invitations to bid, select appropriate bidders, and evaluate the replies. After obtaining the buying information, the computer will print a complete purchase order automatically. And we can expedite or delay delivery action based on specific condition at that time. When the stock-status review indicates that a related item will be needed soon, we will combine that item with others on the same purchase order to the one supplier.

We will accumulate and analyze demands annually in equal 13 periods of 28 days each, instead of unequal calendar months for proper evaluation of trend. Under the present system when you compare February demand with a year ago February, March, or April you must contend with 28-, 29-, 30-, or 31-day factors. We will no longer have that disparity; each demand period will be equal. Analyzing demand trends becomes a much simpler job. Unusual demands will be recognized as we process the daily work, based on the essential criteria programmed in the computer. Where a particular line item exceeds the average, the machine will "kick out" the large order, thus reporting the exceptional item for management review. Tolerance factors will be established in the computer. Should the orders continue to exceed the average but remain within one tolerance factor, a new criterion will be established automatically. If the orders exceed a second factor, there will be no automatic change, but the record will be noted and reviewed. It is estimated that 75 per cent of items stocked will fall within the area for automatic updating of criterion. The remaining 25 per cent will fall within the second tolerance factor and require buyer review before changing the control.

Improved management tools are provided through exception-reporting techniques that give us a good ADP system. We have

built into the system criteria to tell us when the stock-turn ratio for each item is too low or too high, reflecting performance effectiveness; when the individual buyer is overloaded, requiring a redistribution of work, or when he is delinquent in procurement action; when a physical inventory should be taken for specific items, based on low-quantity condition and if within the period desired; when an employee's performance exceeds an established standard, for considerations of an incentive award, or falls below a criterion, for discussion of his shortcomings. Other management devices will indicate customers responsible for an increase or decrease in sales, and by geographical location; signal when the back-order limit established has been reached for each commodity class, i.e., food, furniture, and so on; recommend distribution of warehouse manpower daily in accordance with work at hand; and evaluate vendor performance by scoring each procurement as to quality, delivery, and packaging, and print out a report indicating poor performance.

Part three of the integrated system is the related accounting functions for order-processing and inventory-management operations. Extra dividends are realized as a result of an integrated ADP system—one in which the accounting functions are automatic by-products of the main operation. The daily transactions comprising customer orders, receipts, vendor invoices, and so on are in the system. So are the purchase orders and merchandise due-in. With the customer data in the system we can perform automatic invoicing and produce the accounts receivable. With the purchase order and vendor invoice data in the system we can maintain the accounts payable record and perform automatic vouchering. With the collection transactions we produce the cash journal. From these records we develop the general ledger as an integral part of the system.

Automatic vouchering is a prime example of the management-by-exception philosophy. It is a natural by-product of the accounting procedures. The purchase order data already in the computer is compared with the vendor invoice data and the receiving report data, both daily transactions coming into the system. Likewise the vendor invoice and receipt data are compared. If there is agreement in all respects, the computer prepares the disbursement

journal and certification to Treasury for check preparation. This is automatic vouchering. Where the receipt transaction data and the facts in the pertaining records do not match, the computer prints out a register showing the elements of nonagreement. This is exception reporting. It saves time of the financial manager by selecting the transactions which require action.

Our system has provided for concise and accurate audit trails and controls so that the work of the accountants can be immeasurably improved. They can be free from routine chores of posting and reconciling as is common in this field and will be able to devote more time to aiding management's planning and other tasks.

As indicated previously, the initial application of order processing, inventory management, and related accounting will require a small portion of the available time. Thus, some time is available on the equipment for other functions, such as the Stores contracting "work" performed at a central point. We will get into this area right after getting under way with our first application. We feel it is possible to: (1) determine requirements of high-volume items for all regions accurately and quickly, (2) promptly establish term contracts which will reflect the true national needs, (3) do central expediting for all regions and avoid the conflicting demand for delivery upon one supplier by more than one region, (4) determine when a region is in long supply from stock-status information and also redistribute supply to regions in need of the same items, thus reducing procurement actions, (5) evaluate vendor performance on a national basis as is done for regional procurements (poor performance in one region by a vendor will put us on guard in all other regions), and (6) improve profit and loss predictions which are affected by volumes of business done in each depot at fixed catalog prices, but with varying cost prices because of freight differential between vendor and respective depot.

All kinds of statistics will be stored internally and on tape for such projects as forecasting potential sales. Workload, inventory, manpower, and inspection are related, one affecting the other. The basic statistics can give us the stores work load for the future in terms of lines and dollars. This is the linkage to the inventory required and in turn the basis for determining the buying work

load in terms of the number and value of stock replenishments to support the needed inventory. Inspection factors, such as whether source or destination actions will result from the purchases, and the number of receipts to be expected at the depot will also be obtained. The same data permit us to determine the manpower required for buying, inspecting, warehousing, and distribution of commodities.

If we look into the future we visualize the possibility of a hookup with our larger customers by wire for direct input of agency orders from their computer to a GSA computer. This we conceive as a long-range possibility based on what computers have been able to do in both industry and government. No manually prepared requisition is needed when the computer language is converted to telegraphic language at the sending point and converted back again at the receiving end for machine processing.

We can utilize our computer to predict customer requirements. By recording on tape usage factors for past periods we can control the customer's stock position of common-use items. With this data the computer can tell us how much our customer needs in the future, even considering changing conditions, which can be programmed for. Under either approach, direct-wire input of requirements or computer-determined requirements, the result is resupply without a formal requisition—or the reduction of paperwork.

Warehouse-space management is another feasible and worthwhile program for computer application. Since data are continuously coming into the system from agency requisitions (sales demand) and from our procurement actions (inventory planning), the computer can easily determine our space needs to house the merchandise procured based on the factors resulting from the data analyzed. The computer can also review the depletion of stock for given areas, since the quantity for each location is controlled, and determine space needs and when to rewarehouse the inventory in order to provide more effective use of warehouse space at the lowest handling cost per inventory dollar. This results in optimum service to our customers.

A strong possibility for the future is the establishment of ADP centers, where one computer will serve a number of depots. We

can mark off a geographic area and have all agencies within that boundary submit their requisitions to a central point, where the requisitions will be processed through one computer, and the depot nearest to the customer will be directed to ship that order. To reduce back orders we can have more than one depot fill a particular requisition and still prepare one billing. Before we can get into this type of operation, however, we must first gain experience, which will be done through the operation of the Washington computer, establish a trained cadre of ADP specialists, and develop more sophistication in operating techniques.

System integration of order processing, inventory management, and related accounting is our objective. In the conventional system, carbon copies of documents normally flow independently to each operating unit, where separate records, registers, and reports are developed, maintained, and produced. Under our system we envision an agency document coming into the system, hitting all operating bases, and going into a common GSA file on tape. This we term one-shot documentation.

One firm policy has emerged in GSA from the experience acquired with automatic data-processing applications to date. Conversion from a manual or mechanical system or from one type of equipment to another should never be undertaken until the new system has been preplanned, integrated to the maximum degree possible, and simplified. Only when these conditions are satisfied can a transition be fully justified in terms of time, men, money, and materials.

Charles A. Phillips

A Common Business-Oriented Language for Computers

If a particular agency or business activity has several computer installations which use different makes of equipment, programming for common operations becomes something of a problem as the language used for each machine will be different. As a means of eliminating the necessity for separate programming languages for various makes of equipment, the Department of Defense undertook to give leadership to a project to develop a common business-oriented language suitable for use with any computer. The project was successful and the result became known as COBOL. In essence, COBOL provides a means for preparing the source program manually in English. This program is then translated into the object program, or unique language of the particular computer. The conversion is accomplished by means of a compiler, which is a special program that directs the translation.

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I PROPOSE to tell you of the co-operative effort of computer manufacturers and users to develop a common business-oriented language for computer programming, how and why the Department of Defense became involved, some of the reasons and the problems that generated the effort, what has been done and how it was done. I will also describe in a general and nontechnical way, the end

product of this co-operative effort, COBOL, which stands for COmmon Business Oriented Language.

The idea behind the COBOL project came out of a meeting of "computer people"—users, manufacturers, and teachers—at the University of Pennsylvania Computing Center on April 8, 1959. This group was discussing the theories, approaches, and problems of "automatic programming," in which the computer itself takes over some of the tedious work of coding and organizing computer programs. In reviewing the separate but similar automatic programming languages that had been developed, such as FLOWMATIC, COMMERCIAL TRANSLATOR, and AIMACO, each of which was tied to one or two specific computers, the group concluded that it might be feasible to develop specifications for a problem-oriented, but machine-independent language for programming business problems. The group also concluded that such a project would require a sponsor that was motivated by a well-recognized need for such a language to assure energetic effort, one who must also be completely neutral so far as the various computer manufacturers were concerned, and with a stature and position that would command the attention of manufacturers and encourage the participation by all users of computers. Within this general framework, the group decided to ask the Department of Defense to sponsor a meeting to organize the effort and to give continuing leadership to the project.

The Department of Defense was happy to undertake the project, in fact we were a little embarrassed that the idea had not occurred to us first since DOD would benefit so greatly. Also, a Defense component, the Air Matériel Command had taken the first step through the development of AIMACO, the first recognized effort to bridge more than one computer family with automatic programming. The AIMACO objective had been to develop a single programming language for both the IBM 705 and the Remington Rand UNIVAC.

Now let me tell you something of the Department of Defense's interest in this subject—our computer-related costs and our problems in this field. Without doubt, DOD has a real interest and motivation for support of this effort, for we are probably the biggest user of automatic data-processing equipment in this country.

In early 1959 we had 225 ADP systems in the business area alone with a total of 375 systems projected for the end of 1960. Translated into dollars—and these are approximations—the 1959 costs were over $70 million and the costs for 1960 are projected at around $120 million. These figures include equipment rentals, amortization of purchased systems, programming, operating, and other costs. It has been our experience that the equipment rental (or amortization) is somewhat less than the programming and other costs. While no exact figures are available, we find that the four major tasks of (1) systems design, (2) flow charting, (3) programming, and (4) "debugging," which are usually referred to collectively as "programming," represents roughly one-half of our total ADP costs—possibly more in the first year and reducing in the second and subsequent years. On this basis our total DOD "programming" costs for business problems were about $35 million in 1959 and will approximate $60 million in 1960. I think you will agree that this indicates a major interest in the subject, motivation for action, and a position of stature.

You are all aware of Defense's long-time interest and support of computer development. Since it was a sapling, or more correctly a seedling in the Army Ballistic Research Laboratories, Defense has nurtured the computer family tree with research and development dollars and is continuing to do so even today. Now I would like to tell you something about a few of our current problems. The high costs in time and dollars for computer programming have already been discussed. Let us turn next to problems of compatibility and the interchange of computer programs.

The supply and logistics area represent about 85 per cent of our business-type applications, and in this area our problems can be roughly divided into those at the wholesale level and the retail level. This same division can also be found in most other business-type applications. For our purpose here, let us limit our consideration to the supply function and look at the problem further. Figure 1 shows schematically the necessary relationship between the wholesale and the retail supply levels and activities. An effective supply operation must be integrated so that a supply transaction at one activity is correctly reflected in the data-processing operations of all activities in the complex. For example, the issu-

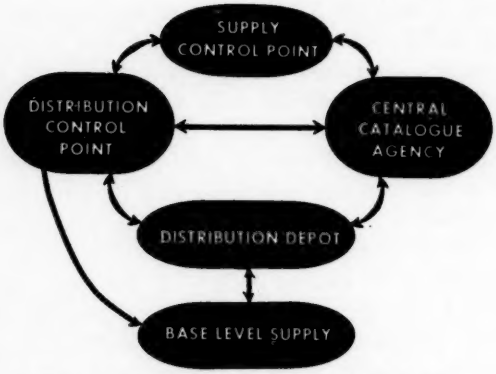

Figure 1. Integration of supply operations

ance of a new or corrected catalog number or description of an item of supply by the Central Catalog Agency must be simultaneously picked up in every activity and at all echelons of the supply complex to avoid error or confusion in future supply transactions.

To be more specific, consider this integrated relationship in a particular supply complex—that relating to medical supplies. For this category of supply, Defense has adopted the concept of "single manager," and Navy has been assigned the over-all single-management responsibility. The "control point" is located at Brooklyn, New York, a Navy activity. In addition, there are ten depots at which medical supplies are carried in stock: four of them are Army depots, five are at Navy shore establishments, and one is an Air Force depot. At these ten stocking points, we already have five different computer installations in this complex, using five different types of equipment of two manufacturers. There are still five stocking points to be heard from, which may, or may not, need computers to handle their data-processing volume. Obviously these ten stocking points need the same basic stock distribution method or system, whether it is in manual form, on a punched-card system, or an ADP system. This leads to the question: can we use the same computer program for the several depots now using ADP? If not, and we must write a different program for each

different type of equipment, how do we know that the different computer programs are identical in results?

There is an obvious solution that has probably occurred to you: use the same make and model computer at all of the supply points in the same supply complex. This approach has been adopted by the Marine Corps in their supply system, and they are now using the same make and model computer at their three depots at Philadelphia, Albany, and Barstow. With this approach, it was only necessary to write one computer program for the stock distribution application at all three locations, which certainly reduced the costs over what would have been necessary if the equipment had not been standardized. Is this a happy answer? Yes—for one manufacturer—but how about the other seven or more, and how are we always sure we have picked the best equipment for the job? There is a growing support for the standardization approach, but there is also a strong belief—to which most of the ADP management offices in DOD are inclined—to view "hardware" standardization at this time as being premature. At the same time, there is no denying the seriousness of the compatibility problem and the need for some solution. A partial answer to this problem would seem to lie in a method by which computer programs for several different equipments could be prepared in a common programming language.

This will give you a general idea of the reasons why Defense was interested in the proposal that we investigate the possibilities and give leadership to a project for developing a common business-oriented language for programming computers.

What did we do? In May 1959 we convened a meeting in the Pentagon using the agenda and the list of participants that was suggested by the original "idea" group. In so doing, we stepped on lots of toes, for there were many persons prominent in the field of automatic programming who were omitted from the invitation list. Some such persons may be in this audience, and, if so, we apologize for not inviting you and assure you that we recognize the need for and ask your help in this continuing program.

The two-day meeting was attended by approximately forty persons prominent in the computer field—representatives of most of the computer manufactures, large-scale users of computers in

government and industry, educators, and consultants. This group discussed at some length the following major questions: Was the project feasible? Was it premature? How could it be accomplished? Coming out of the meeting was a complete agreement as to the real need for such a common programming language. As to the feasibility of the project there was general agreement that it could be done but a difference of opinion as to how big and difficult the job was. We also agreed that it was not premature; in fact the effort was very timely.

We discussed at some length the basic characteristics of the proposed language, and, while there were many views, we did generally agree on these three: (1) it would be oriented toward business-type problems, (2) it should be machine independent, and (3) it should be open-ended and expressed in English. Not specifically stated, but implied in the last characteristic, it should be easy to understand. We also concluded that the project should be divided into three phases or time-frames, each to be undertaken by a separate committee or task group, and all those who attended the first conference were given an opportunity to participate in the phase or task of their choice.

The first group was called the "Short-Range Task Force." This group was given a very early target date of September 1959 to come up with an initial language—something that could be used —possibly a composite of the then-existing automatic languages: FLOWMATIC, AIMACO, and COMMERCIAL TRANSLATOR. The emphasis in the first group was on speed with a full recognition that the initial product would have deficiencies. The membership of the group was principally from computer manufacturers; six of the principal manufacturers participated in this effort together with representatives from three government agencies and some participation from a consulting firm.

The second group was called the "Intermediate-Range Task Force," and they were originally given a target date of 1961 to refine the initial language or to develop a language oriented toward the systems level as distinguished from the programming level. Membership in this committee is very widely held, including most of the major industrial users of computers, consulting and public accounting firms, and a number of government agencies.

Although there are several computer manufacturers represented in this group, the users outnumber the manufacturers, unlike the short-range effort.

We recognized that the long-range effort would be very important, so we established some very general terms of reference and appointed a small planning committee composed of the vice-presidents of two major computer manufacturing companies with the vice-president of the Southern Railway as Chairman. The long-range objective was considered to be the development of a universal computer language which would encompass scientific and engineering uses of computers as well as business uses.

We generally refer to the total effort of these various groups together with interested but not actively participating observers, as the Conference on Data Systems Languages, of which the development of COBOL is the first major step. The program has generated widespread interest and support as information about it has spread, not only in this country but abroad as well. Our conference mailing list now includes several hundred agencies and firms including all computer manufacturers in this country and several abroad, most of the public accounting and consulting firms, and a good cross section of the large industrial users of computers.

We reached our first target date in September 1959, when the Short-Range Task Force made an interim report to the Executive Committee meeting at the Harvard Business School. The Short-Range Task Force had divided their work into four general areas: (1) data description, (2) procedural statements, (3) applications surveys, and (4) usage and experience. They had concluded that a common business language was desirable, practical, and within sight. They had gone beyond the original terms of reference that established the group and had developed some tentative or preliminary specifications for a programming language. I think the September report of this group might be considered as the framework upon which COBOL was later constructed and a level above the then-existing languages.

The Short-Range Task Force was fired with enthusiasm for the project, and they recommended to the Executive Committee that the target date be extended and the group continued to finish the job. These recommendations were readily agreed to; in fact, I

think the Executive Committee would not have been particularly surprised if a second extension of time had been requested later. This did not happen, though, and in December 1959 the Short-Range Task Force submitted its final report, which contained the specifications for COBOL.

Meeting in Washington in January 1960, the Executive Committee accepted the report and recommendations of the Short-Range Task Force and authorized its publication after editing. The Short-Range Task Force was dissolved and an *ad hoc* committee appointed to work out techniques for maintaining COBOL after it was published.

Next I would like to discuss briefly the specifications of this new programming language and some of the things we hope it will do. In Figure 2 I have taken some liberties to illustrate my point by

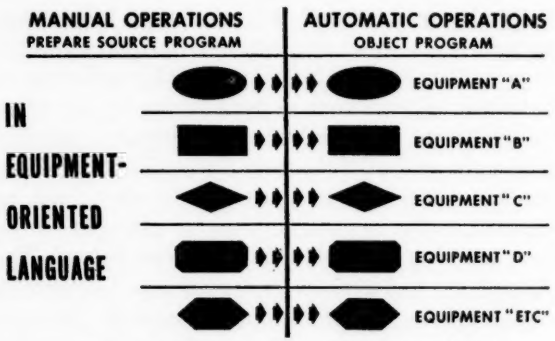

Figure 2. Programming without COBOL

showing a line between the "source program," which is manually prepared, and the "object program," which is the unique machine language of the specific computer on which the program will be run. As you see, in present-day nonautomatic programming, there is no difference between the "source program" and the "object program." In other words, you program the computer in its own language, and they are all different. Now let us look at Figure 3, which shows how programming is done under the COBOL system. Under this system, the source program is prepared manually using

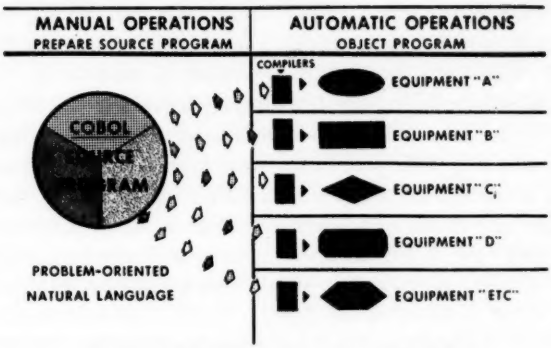

Figure 3. Programming with COBOL

a natural language—English—which is oriented to the problem involved rather than to the computer on which it is to be run. The "source program" is then put into machine-sensible form (through punched cards, punched paper tape, and the like) and is then translated or converted into the "object program" or unique language of the particular equipment. This translation or conversion is accomplished through a computer, and we refer to the computer program which directs this translation as a "compiler."

Figure 4 shows graphically the composition of COBOL as the "source program" language. As depicted, the COBOL specifications are presented in three divisions—procedures, data, and environment. The first division or element of the COBOL specifications is called the procedures division. This division contains the language to be used in describing how the data is to be processed. In this division you find the action verbs for the arithmetic such as "add," "subtract," and the input/output operations such as "read," "write." Here also are the instruction words as to logical steps required to obtain the desired results and alternatives such as "go," "alter," "perform." To make the language more easily understood by systems analysts and managers, COBOL contains words that are ignored in translating the "source program" to the "object program." These words, which have no significance to the computer, are referred to as "optional" words, or "noise"

words: examples are "however," "and," and "to." In all, the initial specifications of COBOL utilize a total of 37 characters for words plus 19 more for punctuation, relationship, and so on.

As also shown in Figure 4, another part of the COBOL specifications is the data division, which is used to describe what data is to be processed. This part of the language is used to describe the records involved, record size and labels, the fields to be used as reference, the tables to be used in computation, the nature of the input data, the form of the output, and similar information needed to describe the what of any data-processing program.

The third division of COBOL is called the environment division. This division describes the equipment to be used, its name and configuration, the size and type of memory (or storage), the memory areas that are to be shared, the input-output techniques, the controls, and other characteristics that have a major effect on any program. These equipment characteristics are usually peculiar to a single computer, and the environment division of COBOL is therefore the least compatible between different makes and models of computers. This means that a computer program written in COBOL for one computer would require a revision of the environ-

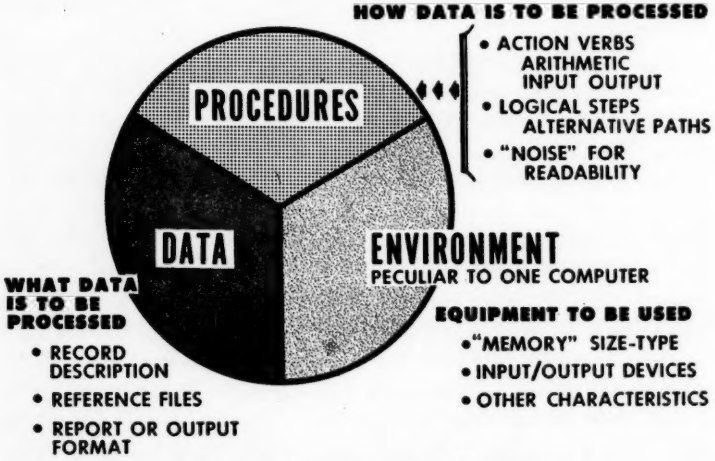

Figure 4. Source program elements

ment division portion of the program to use it on a different computer.

Figure 5 is intended to show the "automatic" conversion process whereby the "source" program written in COBOL is converted to the "object" program in machine language. The "compiler" shown in the center of the figure is sometimes referred to as a "translator" or "processor," but whatever it is called its purpose is to change the English language program, prepared manually, into the coded instructions that will operate the computer. Such "compilers," as I prefer to call them, are in fact, computer programs; they are not a piece of "hardware"; they are different for each computer and are developed by the manufacturer of such computers.

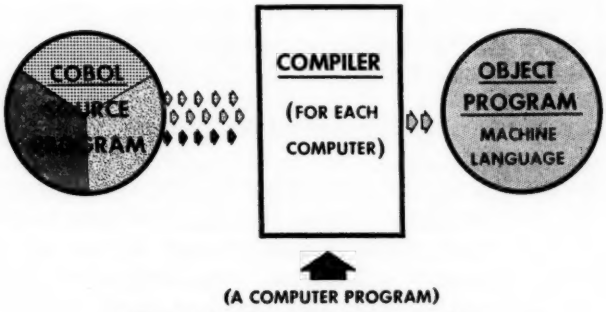

Figure 5. "Automatic" conversion

To illustrate the difference between a program written in machine language and the same program written in COBOL, we refer to the last two figures in the sequence. Figure 6 illustrates the machine instructions or program written for a widely used large-scale computer, which directs the machine in its own peculiar language, to calculate the employee's withholding tax deduction or FICA. There are lots of numbers in this program sequence which would be completely unintelligible to the average systems analyst or manager unless they had been to programming school for this particular computer. If you will now refer to Figure 7 for comparison, you will see the same program instructions to

```
LOC  OP SU  ADDRESS      POLIN SER  REF
09524 9 05 21215 J8/5  20540      *A62
09529 9 05 21215 J8/5  20550      *A62
09534 9 05 21215 J8/5  20560      *A62
09539 2    00500 0500  20570
09544 R 00 00300 0300  20580      AA03
09549 R 00 21295 J295  20590      *A75
09554 1    09279 9279  20600      AY46

09559 B 00 00005 0005  20605
09564 F 00 05356 5356  20610      AL27
09569 1 00 09344 9344  20620      AZ11

09574 B 00 00005 0005  20625 162
09579 F 00 05361 5361  20630      AL28
09584 U 05 05352 5TV2  20640      AL27
09589 9 05 21215 J8/5  20650      *A62
09594 1    09344 9344  20660      AZ11

09599 B 00 00005 0005  20665

MACHINE PROGRAM CONTAINS 62 LINES

09619 9 05 21215 J8/5  20700      *A62
09624 1    09344 9344  20710      AZ11

09629 A    10074 #074  20720      BC21
09634 H 00 05378 5378  20730 163  AL31
09639 N 00 09384 9384  20740      AZ19
09644 6 00 00632 0632  20750      AA48
09649 1    09654 9654  20760      BA27

09654 8 01 00345 0305  20770      AA15
09659 4 01 21033 J0T3  20780      *A03
09664 L    09709 9709  20790      BA38
09669 8 01 00341 0311  20800      AA12
09674 4 01 21034 J0T4  20810      *A04

LOC  OP SU  ADDRESS      POLIN SER  REF
09679 L 01 09834 98T4  20820      BB18
09684 4 01 21033 J0T3  20830      *A03
09689 L 01 09919 99/9  20840      BB35
09694 4 01 21035 J0T5  20850 164  *A05
09699 L 01 09994 992A  20860      BC04
09704 1    10004 #004  20870      BC06

09709 H 00 21173 J173  20900      *A56
09714 P 00 00668 0668  20910      AB05
09719 N 00 09729 9729  20920      BA42
09724 M 00 09734 9734  20930      BA43
09729 1    09669 9669  20960      BA30

09734 P 00 05378 5378  20970      AL31
09739 M 00 09754 9754  20980      BB02
09744 G 00 05378 5378  20990      AL31

09749 1    09799 9799  21000      BB11
```

Figure 6. Machine program for "compute FICA"

calculate the employee's withholding tax deductions, written in COBOL. Here we find six English-language statements containing a total of 49 simple words or numbers, and, if you will accept compound words such as "gross-pay" as a single word, there are only 35 words or numbers. The nice part about the COBOL program is that it can be quite readily understood by the systems analyst or manager and that it is essentially the same for any computer.

```
▶ MULTIPLY gross-pay BY 0.030 GIVING
  weekly-fica.

▶ IF weekly-fica PLUS annual-fica EXCEEDS 126.00
  THEN COMPUTE weekly-fica FROM 126.00
  MINUS annual-fica.

▶ SUBTRACT weekly-fica FROM adjusted -pay.

▶ ADD weekly-fica AND annual-fica.

▶ ADD weekly-fica AND quarterly-fica.

▶ ADD weekly-fica AND monthly-fica.
```

Figure 7. COBOL version of "compute FICA"

One of the major advantages that the use of COBOL can bring to the data-processing community is a better understanding and a closer relationship between the manager of men, money, or material on one hand and the computer on the other. Today there is a technical barrier between the manager, the programmer, and the computer. I think most managers have little or no doubt that the equipment has the capability of doing what it is instructed to do, but there is some doubt on the part of some managers that the equipment is properly instructed. This does not imply a distrust of the programmer's competence but rather an inability to get programmers with experience and a thorough knowledge of the subject-matter area in which they are programming. Unless the manager has taken a programming course, or the programmer has grown up in the business, such a technical barrier may be present. With COBOL this barrier is substantially reduced, since the manager can understand the English-language "source" program and he has confidence that the computer will do what it is instructed.

The use of COBOL should also result in a substantial reduction of programming time and cost. Although we have no experience to date with COBOL, we do have some experience with AIMACO, a first cousin or progenitor of COBOL, which was developed by the Air Matériel Command. To test the effectiveness of the AIMACO system, the AMC conduced a controlled experiment in which two programming teams of equal competence programmed the same application, one team using AIMACO and the other team using a sophisticated assembly technique on which they had eighteen months' experience. The team using the conventional, but advanced, method of programming and coding required a total of 15,500 hours to complete the four steps of (1) systems design, (2) flow charting, (3) programming and coding, and (4) "debugging." The team using the AIMACO system, required 9,500 hours in total. They gained nothing in the systems design and flow-charting phases, in fact there was a loss in flow-charting either because of the newness of AIMACO and the team's unfamiliarity with the system or the fact that it required a more simplified chart. On the programming and debugging phases, there were tremendous gains in time with an over-all reduction of man-

hours of about 39 per cent. Since COBOL is generally recognized as a more effective and powerful language than AIMACO, Defense should be able to save millions of dollars a year by using COBOL, even if it is only applicable to a small percentage of our programs.

The COBOL report and initial specifications are complete and have been edited and submitted to the Government Printing Office for publication. The COBOL report may be ordered from the Superintendent of Documents, U.S. Government Printing Office, Washington 25, D.C. at 75¢ per copy under the title *Common Business-Oriented Language, April, 1960*. They will be distributed to the data-processing community through the mailing list of the Conference on Data Systems Languages within the next few weeks and will be on sale at the Government Printing Office. I am convinced that the initial specifications of COBOL are technically sound, but to be effective COBOL must be dynamic; in other words, it must be subject to continuing change and improvement. To meet this requirement, a Maintenance Committee, composed of representatives from the computer manufacturers and the large representative computer users, has been set up and has already approved several supplements to COBOL.

With the completion of the initial specifications of COBOL, the Conference on Data Systems Languages (CODASYL) was reorganized into two major efforts, one to maintain and strengthen COBOL, the other to continue the promotion and conduct of research on the problems of communication between men and machines for the development of languages of the future. This second effort is the responsibility of the CODASYL Development Committee, which represents a consolidation of the intermediate- and long-range groups that were first established. The Development Committee is composed of representatives of computer manufacturers and computer users from both industry and government working as task groups on different problems of business-language development.

Most of the major manufacturers have announced their intention to provide compilers for COBOL, and some of them should be completed by fall. Many of our Defense activities and several large industrial firms are now beginning to program with COBOL, and we should be able to see some final results within 1960. The

ultimate success of the venture will be determined by experience, but I have no doubts as to the result. Our efforts of the past year have been remarkably successful, particularly when you consider that COBOL is the product of a spontaneous and voluntary effort. Major credit for results so far must go to the extremely co-operative spirit displayed by the computer manufacturers and their fine support of the effort. The ultimate and long-range success will also be due to a continued co-operative effort—this time between the users and the manufacturers.

Kenneth Stiles

The Space Age

The space age has brought forth many exciting developments in science. At the same time it has produced problems of management which until recently did not exist. As more and more has become known of the physical world, the sciences have become more and more specialized. Much of the research work today, however, is interdisciplinary in nature, resulting in problems of communication between the specialists. As a means of combating this problem, management has turned increasingly to the team approach, in which the skills and contributions of many are co-ordinated into a unified approach to particular problems. If the best allocations of human and material resources are to be obtained, this management concept must be carried further. Both industry and government must develop systems-management attitudes in which there is a maximum of interaction between them but at the same time broad operational latitude for the manager and his research teams.

Mr. Stiles is Vice President for Plans and Programs, General Dynamics Corporation.

SHAW once said that science never solves a problem without creating ten more. This sage observation is most appropriate in assessing what I would call the upward spiral of scientific complexity, which is both the blessing and the bane of this, the space, age. I need not enumerate the current accomplishments of science in power, communication, and transportation, or the exciting possibilities it holds out for future benefit. But at the same time, as we reach for greater speeds, penetrate more deeply into the nature of

matter, have to deal with more exacting environments, the nature of the management problem will be correspondingly more difficult. And the costs will be inevitably greater. Those of us who are concerned with defense planning and management, in or out of government, are presented with these problems in their most acute form. For the impulse to complexity is the more or less direct result of unusually rapid scientific and technical progress. And defense needs since World War II have been the greatest single stimulant to scientific advance.

Since the emergence of rational science during the Renaissance, there has been a steady trend toward specialization. At first all was general. A Francis Bacon was a courtier and financier as well as a philosopher and scientist, a Leonardo da Vinci was a great artist, an imaginative engineer, and a notable scientist. But as more become known of the natural world, as new and promising areas of inquiry developed, it became literally impossible for one individual, however gifted, to make significant contributions in all fields. The first departure from science as a general philosophy was the division between biological and physical sciences, though as late as the mid-eighteenth century, men like Franklin were interested in all phases of natural philosophy.

About 1700, mathematics became a separate discipline. Then, as far as the physical sciences were concerned, classical physics and chemistry became separate disciplines early in the eighteenth century. Engineering, apart from military engineering and surveying, achieved professional status between 1850 and 1870. Since then physics, chemistry, and engineering have been further specialized with the result that significant advances were made in ever more sharply defined areas. Specialization in the physical sciences and engineering, however, created serious communication problems among the various disciplines which hampered scientific progress and technical developments. Of course, there were men like Einstein, who by sheer brilliance surmounted the communication barriers and on a theoretical plane established a synthesis with revolutionary implications for science. Unfortunately, Einsteins are rare indeed. Hence the appearance of what have been termed "hybrid sciences" like physical chemistry, which links two sciences together.

This helped but did not solve the communication problem. A rough solution was first worked out by applied scientists and engineers in industrial laboratories. They were confronted with the design elaboration of small-scale systems such as metropolitan telephone systems, urban traffic control systems, and other such relatively complex undertakings. It was soon realized that a wide variety of disciplines was essential. On the planning level another problem became manifest. This was the co-ordination of the hundreds or even thousands of components of a large-scale system, many of which required individual design development. This gave rise to the need for the team approach.

Although this approach existed in some of the advanced industries prior to World War I, it was that war and later the industrial mobilization of World War II particularly which was responsible for a widened application of the systems approach and with it the emergence of yet another professional discipline, the engineering scientist, or systems analyst, as he is sometimes called.

The Manhattan Project, as you may know, is an early and excellent example of teamwork applied to an extremely complex program. Thousands of physicists, chemists, metallurgists, engineers, architects, administration and production people from the universities, government laboratories, and private industry worked together as a team. Yet as large and as complex as this research project was, the administration group was surprisingly small—about three hundred in all.

The hydrogen bomb project utilized a similar approach and achieved equally spectacular results in a very short period of time. It should be noted, of course, that both projects were organized on a "crash" basis, which permitted the scientist-engineer teams maximum latitude for alternative approaches to the many difficult problems.

Although such a team approach tends to operate most effectively in a crash environment, it stands to reason that the entire research and development program of our defense establishment cannot be put on this basis. It would be both uneconomic and unwise. But in view of the fact that our defense planning is taking on more and more of the aspect of a scientific and technical race, we can and must deal with the problem of complexity as best we can.

There can be no complete answer because the solution involves politics, in the classic, not the partisan, sense.

In our democratic, decentralized nation, it is impractical and contrary to our political beliefs that such a large portion of our economy as the defense industry represents should come under the detailed supervision of the government. When we come to consider in addition that the greater part of this nation's scientific and engineering personnel and almost all of its production and management capability is outside of government, logical defense planning not only is an extremely complicated task but must rest on a high degree of mutual understanding and co-operation in balancing military objectives with those of a free society. The tie-in between government and industry must be close.

Like the communication barriers which existed between he various scientific and engineering disciplines, a similar barrier has hampered working relationships between planners and managers and their civilian counterparts. Again it has been a question of specialization and of responsibilities. On the one hand is the professional military man (and in this category I include those out of uniform as well as those in uniform), cognizant of strategic requirements, anxious to maintain the most effective force-in-being in a constantly changing state of the art, yet subject to all the economic and political pressures upon government. On the other is the industrial manager, who must organize the requisite scientific, engineering, and production capability to carry a large-scale project through to its specified conclusion. He, too, is subject to pressures, such as meeting design objectives, keeping his personnel together, his plant operating efficiently at optimum capacity and making a profit for his stockholders. Not the least of his responsibilities is the generation of creative research which will influence the state of the art and hence have an important bearing on future defense planning.

Prior to 1945, with the exception of the Manhattan Project and a few electronics projects, the lack of a definite communication between government and industry was not a serious problem. World War II was fought generally in the classic pattern. Industry was concerned with management and production. The armed forces were concerned primarily with strategy, tactics, and logis-

tics. It is true that the services became interested in operations research and were influenced by the scientific approach to operational and logistic problems. But apart from an appreciation of the value of the scientific method for the solutions to complex nonscientific problems, the services were still primarily concerned with their own professional objectives and operating philosophies.

Since then, however, the scientific and technical race in the weapons field has altered strategic concepts. It has also tended to merge military and industrial planning, especially in the vital area of research and development. Adequate communication and viable teamwork on the management level has now become an absolute necessity. The various services and some, but not all, of the defense industries have applied the team approach to the over-all management problem. Top civilian-officials, officer-scientists, and development-engineers have created systems teams to co-ordinate programs ranging from the development of nuclear submarines to intercontinental ballistic missiles. Defense industries in many areas have built up a systems capability, and some have accepted the responsibility to manage the design, development, and production of a complete weapons system. Much has been done in this area, not only in devising clear channels of communication but in learning to operate as cohesive units. Much more must be done by both industry and the government if we are to cope successfully with the upward spiral of scientific complexity.

Of importance, in my opinion, are clearer statements of national defense objectives from the highest levels of government. These would provide a better sense of direction in the services and permit industry to allocate more effectively whatever human and material resources seem necessary for each task. Once adequate long-range planning is projected, it will be essential for industry and the services to cultivate a systems management attitude, which will permit a maximum of interaction between them but still preserve a broad operational latitude for the industrial manager and his systems research teams.

In this latter connection, management, whether it be governmental or industrial, must have a clear understanding of what is research and what is development. And this I bring most earnestly to the attention of you who form so important a part of manage-

ment. Confusion of these two terms has caused delays and cutbacks in many of our important programs. Research, especially basic research, frequently deals with imponderables. It investigates many avenues. It may, and frequently does, end up in blind alleys or provide information in nonrelated areas or suggest alternate lines of development. A certain amount of preplanned structuring can be employed in scientific research so that some idea of the end result may be gained beforehand. But at any time, a breakthrough can, and frequently does, not only alter a line of research but may produce a radically different end result with applications far different from those originally anticipated. Promising scientific ideas may prove unpromising, and conversely long-discarded projects may suddenly take on new significance. The extent of knowledge at a given time, accidents, intuition, and an endless number of variables are all involved. Although research is highly unpredictable, and expensive, it is the nucleus for all technological advance. There should be no criticism of it on the grounds of unnecessary duplication.

Research that produced a guidance system for satellites in outer space also led to the guidance techniques that are utilized in submarines in inner space. The military requirement for improved means of locating an enemy resulted in the scientific program that produced radar. The peaceful uses of this wonderful device range from air safety and highway traffic control to the location of schools of fish for commercial fishermen.

The need for destructive forces which could only be produced by atomic means has led to a most dramatic peaceful program of electrical energy production and scientific breakthroughs. Scientific exploration on the problem af desalting ocean water for submarine crews may well lead to an agricultural revolution in many of the parched areas of the world.

I would like to emphasize that many of these efforts produced results in fields that were unrelated to the original goal. Also, these efforts were often being carried out in what appeared to be duplicate or parallel programs at some point in their life.

Development on the other hand is more predictable, if based on proper research. And as you all know, it is in the development stage that decisions on prototypes are crystallized and detailed

specifications drawn up. Once a decision on development is taken, the systems team should be comprehensive enough to govern its own costs, subject, of course, to the over-all fiscal requirements of the parent organization. Effective development of a complex system can run into many unforeseen problems, both technical and otherwise. Undue concern from above for costs at critical junctures in the development cycle can hopelessly confuse a project.

These are only a few random thoughts and the barest outline of a management attitude or philosophy geared to the problem of increasing complexity. It is worth stating that never again will this country have the luxury, if that it be, of a year or two or three in which to build from the utter weakness of a Pearl Harbor day to the overpowering strength of a victory day. We shall have to fight with what we have at the outbreak of the war. Any plan which assumes prolonged periods of strife—periods in which one power will have months and years in which to organize such large transoceanic logistic feats as characterized World War I and World War II—makes no sense at all. To think of some mythical mobilization day when plants now in stand-by will be reactivated, or plants producing civilian goods will convert their assembly lines to items of war while atomic bombs rain about them, is utterly unrealistic. We should be doing today those things that in the past were done on mobilization day.

Whatever improvements are made in defense or industrial management, whatever progress is charted in the weapons field, will be the responsibility hereafter of our scientists and engineers. Our national security is largely in their hands. This means that we should devote a lot of time, energy, and funds to the educating and training and scientific orientation of our youth. In addition, it must be the responsibility of both industry and the government to provide environments which stimulate scientific and technical endeavor.

T. D. Bloomer

Integrated Accounting through Data Processing

Two possible approaches may be used to achieve integration of data processing. One is through utilizing a central processing unit to encompass all applications. If this approach is used, the computer must initially have all the basic components that will be required in the ultimate system. Perhaps the greatest disadvantages of this type of integration are lack of flexibility and unused capacity. The second approach involves the use of several computers which are tied together with a communications system. Integration is achieved by use of a common random-access file, and all records that are affected by a particular type of transaction, regardless of their functional location, are updated by one input of the data through the system.

Mr. Bloomer is Marketing Representative, Federal Systems Division of International Business Machines.

TODAY I will not discuss data-processing equipment, but rather the question, "How can integrated data processing be responsive to the accountant?" To answer this question requires the review of the internal systems requirements of federal government accounting, the role of the accountant, the external systems requirements which affect this mission, and, finally, two approaches to accomplish this job.

The most notable feature of federal government accounting is the blend of functional areas that comprise the total accounting

job. Each installation is made up of logistics, fiscal, and personnel applications. Even those that are devoted primarily to one functional area have significant requirements in each of the others. Consider for an instant a depot. The principal mission is to store and distribute supplies; but for each supply transaction, there is a corresponding fiscal effect. A depot will issue an item to an installation. This would be a decrease in item stock of the depot, but at the same time would have to be recorded as an accounts receivable in the fiscal books. Likewise, the finance centers of the various services are primarily concerned with issuing allotment checks. To accomplish this job, however, many people are required, and so personnel management is important. Installations differ, but only in the proportionate blend of the functional areas that exist. Installations are similar to the extent that each of these functional areas exist and is significant to data processing.

Air Force bases and Army posts, camps, and stations are notable in that there is an equal blend between each of the functional areas. Figure 1 indicates most of the major applications at an Army post, camp, and station. Here it is easy to note the relative stature

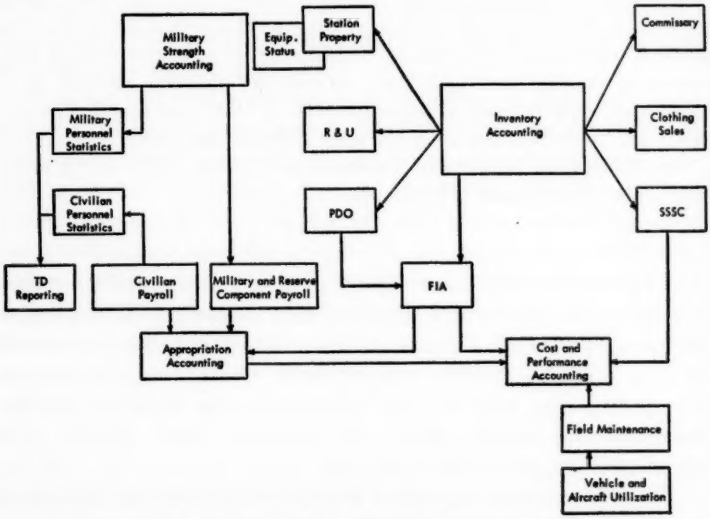

Figure 1. Class I: Integrated accounting

of the application areas and the relationship that they have to one another. This chart highlights the integrated nature of the entire accounting system. We often hear of integrated data processing, but the fact remains that the accounting system is integrated in and of itself, and consequently any application of data-processing equipment to this job must be integrated.

A second internal requirement of federal government accounting is the result of its unique budgetary aspects. Many records must be posted from any one transaction. Again, referring to the post, camp, and station integrated accounting chart, let us trace the effect of the receipt of an item of supply from a depot. First of all, the item inventory must be increased. Secondly, the financial inventory accounting records must be updated, recording this receipt. Fiscal appropriation and fund-accounting records must be posted to record the reduction in undelivered orders and the fiscal liability that this installation has to the depot. Finally, the general ledger of the station must be posted to record the increase in inventory assets and the increase in the liability.

The development of cost-based budgeting and cost accounting in the federal government has added another dimension to the requirements of the accounting system. The element of cost control is the basic component of effective financial management. Managers must be provided with timely cost data in order to apply resources effectively and accomplish the mission within the cost ceiling. Trends and exception conditions must be immediately noted. Historical review of an accomplished fact will lock the barn door, but the horse may be out.

Financial control also embodies fund control. In cost accounting we are referring to the consumption of resources, but in funds we refer to the contractual obligations of the government. Obligations represent the utilization of funds and will eventually result in cost, but because of procurement lead time and inventory, obligation of funds and cost are not synonymous. Since these other manageable factors differentiate cost from funds, fund management is a separate entity. This is emphasized by the fact that cost management applies to the consumer while fund management applies to the procurer. Procuring agencies must also have timely reports of trends and exception reports as the conditions occur.

Moreover, all the basic records pertaining to fund and cost control must be available to inquiry. Close and constant touch is necessary to assure the best utilization of resources. At the same time, many of the applications that we are considering have a strategic nature. The basic mission of an installation supporting a strategic unit is to ensure that this unit is fully supplied at all times. Another area of great strategic importance is the maintenance of major items of equipment. No application is more important to the Air Force than to maintain complete stockage of spare parts to assure that aircraft are operational. These strategic missions establish requirements far outweighing all others. Less important criteria are justifiably waived in consideration of them.

The role of the accountant in data processing gains a clearer perspective after analyzing these requirements. The accountant should be a systems manager. The most basic reason for this is that all applications have a financial effect, and so it is the responsibility of the accountant to maintain and ensure the fiscal propriety of all transactions. In addition, the accountant is the operating official who has responsibility for interpreting and analyzing financial data. The accountant advises top management of appropriate corrective action for financial applications. In this role, he joins other staff agencies who have a similar responsibility in the management of item stocks, personnel, and manpower. This last aspect of the accountant's job must be continually borne in mind as must be the traditional staff responsibilities in any organization. It is easy for a data-processing system to violate traditional staff responsibilities and, in so doing, to usurp the responsibilities and the authority of that staff agency. This probably has happened to the accountant.

External systems requirements that affect data processing are important. Consider the work load and the reporting requirements within the federal government. Everything happens at the end of the month, at the end of the quarter, or at the end of the fiscal year. Secondly, the compatibility of one system to another is an important consideration. Single-line punch-card requisitioning has been initiated in the military service, which highlights the requirement of one system communicating to another. Each system within

the federal government must have a built-in flexibility with mobilization potential; it also must be equated with a reduction in mission requirements. Finally, funds are in short supply; and while economy is just good business, it becomes even more important in the light of the restriction on money.

Let us now look at two approaches to integrated data processing, taking into consideration the internal and external systems requirements enumerated above. First of all, we shall take an approach utilizing one central data processor to encompass all applications. Here we will have a unique problem of applying a computer which has all the basic components that are going to be required in the ultimate system. More specifically, we have some applications that require a random-access-type memory and other applications that can best be processed with magnetic tape. There are a great many applications, and to absorb them into an integrated data-processing system will require considerable time. If we assemble all the basic components of an ultimate system, we must accept unused capacity in our data processor. It is claimed that data processors are modular in construction and that we can assemble only those components necessary to do an individual job. As other applications are absorbed, additional equipment would be added to the system to meet the expanding demand. This is not entirely true, for simply to assemble the basic central processor, which has the ability for expansion, we are establishing ourselves at a level of mechanization which is going to result in unused capacity during the initial stages.

Considering changing mission requirements, we no sooner start a project when some of the requirements change. Consequently, it is as presumptuous to assume that we can assemble the basic components of an ultimate system as it is to assume we can develop an ultimate weapon. Even if we do put together within one central processor all the basic components of an ultimate system, we must establish priorities of processing. This is due to the proportionate share of work that must be accomplished at the end of the reporting period. If we were to design our system based on the end-of-the-period requirements, it would be uneconomical at all other times. We then must conclude that the system would be designed to meet average requirements. With one central processor, valuable

time would have to be allotted at the end of the period to each of the operating agencies, including the accountant, to accomplish their respective jobs. We would find that at the end of the month the requirements of some staff agencies would have to be sacrificed to meet the processing requirements of others. This is an important consideration in our determination of responsiveness.

A system with one central processor designed to perform integrated accounting, by necessity, must be a sophisticated system. As we increase the complexity of a data-processing system, we may remove it from the understanding of operating officials. This places the operating departments in a position of dependence on those who are knowledgeable about equipment. These same people, however, may not be knowledgeable about your job and your unique requirements. It is difficult to visualize how the equipment specialists can establish priorities in regard to the requirements of the operating departments. In any event, if a system is so sophisticated that it is outside the comprehension of operating officials, it hardly can be totally responsive to them.

In contrast to the one central processor approach, let us look at another way of accomplishing this same job. In this case, we shall use a multiple number of processors. We shall apply a processor in each of the functional areas. Where the transaction originating in one functional area affects records maintained in another, we shall let the processors communicate to one another. We shall plan for a totally integrated data-processing system but shall chop it up into the more manageable functional areas. We shall apply a system to individual applications with the basic components to do that specific job. As we progress to other applications, we shall expand this basic equipment. When we cross over functional areas, however, we shall establish an additional processor and actually connect the two systems.

In breaking up the total job, we shall be better able to apply increments of equipment specifically designed to accomplish each application. We shall be able to do this, however, without absorbing a significant amount of costly unused capacity. Moreover, when we reached our ultimate system, we would have more than one central processor operating. In fact, we would achieve simul-

taneous processing in each of the functional areas. This would be a giant stride in meeting all work-load requirements without establishing arbitrary priorities.

In approaching the functional areas with individual, but connected, systems, we can adhere more closely to traditional staff lines. Staff responsibilities are not so apt to be violated and authorities usurped. The equipment can be centrally located or placed in the appropriate staff agencies with connecting communications channels. A significant advantage in this approach lies in the fact that the system can grow with the ability of people to absorb the advancements. This applies to programmers and analysts as well as to the operating officials. Costly equipment can remain unused or be inefficiently used due to the inability of people to accept the new technology.

Sometimes, the first reaction to this approach is the question, "Well, how can this be an integrated system with more than one central processor?" The best possible way to answer this is to portray the system graphically. Figure 2 shows three processors all connected to a common random-access file. The personnel system also utilizes magnetic tape. Integrated accounting is achieved by virtue of the random files. Take, for instance, our example of the post, camp, and station receipt of an item of supply. All records (item inventory, financial inventory, appropriation and fund accounting, and general ledger) are updated in one pass of the transaction through the system. This ability is exclusive to random-access storage and is called in-line processing. Since the updated records are contained within the random-access storage and are available to the financial processor as well as the logistics processor, financial reports can be written directly from storage even though the transaction originated in the logistics system. Bear in mind that, while the logistics system was processing this inventory transaction, the fiscal system is workng on an entirely different application. This is also true of the personnel system. A magnetic tape is updated with master personnel records, but where the transaction has a financial impact, such as a pay raise, the information is communicated to the random files. The fiscal system prepares the payroll.

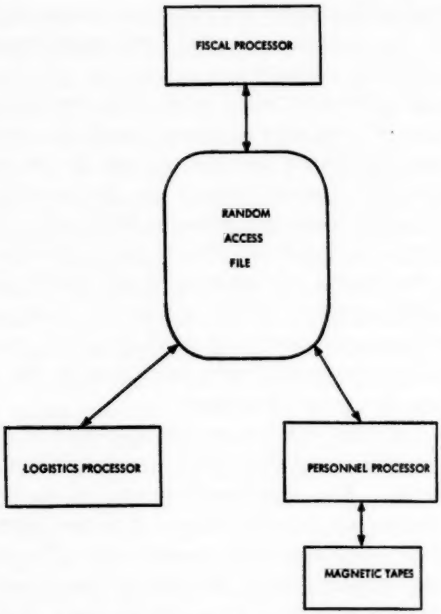

Figure 2. Integrated accounting through data processing

In terms of responsiveness, the multiple processor approach has the following merits:

1. Equipment is specifically blended to match the blend in the functional areas. Each installation varies, but the three-processor approach is common to all sites.
2. Multiple records are updated on an in-line basis with one pass through the system.
3. With all records updated in one machine process, exception conditions are immediately noted and brought to management's attention.
4. Inquiries can be made to the random files at any time with a minimum of interference.
5. End of period work loads are efficiently accomplished.
6. Phasing in three processors meets personnel capabilities and avoids costly unused computer capacity.

7. The system is more economical to operate because each processor is specifically adapted to the functional area.

8. The organization of this system is adapted to existing staff responsibilities.

9. Each functional area can be processed simultaneously.

Integrated accounting through data processing can be approached in a number of ways. Making the system responsive to the operator and to the system manager is the very best way. Placing the system within the grasp and control of the user, we increase the chances of success. Moreover, we will ultimately achieve the most self-sufficient and progressive installation possible. Let us not talk about accounting for accounting's sake or computing for computing's sake. Let us adapt the system to meet our real needs. A multiple-processor approach is the most responsive to these needs.

W. O. Reuther

An Integrated Analysis and Planning System

The use of electronic equipment for handling large volumes of data in the recording and reporting function is well established. The use of computers, however, in some of the broader management functions, particularly in planning through simulation and model making, is still relatively underdeveloped. If management is to develop into its full potential, the total administrative function must be integrated into a single autonomous system. Computers provide a means for accomplishing this. An integrated data-processing system can remove duplication, permit any desired correlation of data, and test alternatives through the use of models.

Mr. Reuther is with the Federal Systems Division of International Business Machines.

THE application of data-processing equipment is already well advanced. What then is its deeper implications? I believe you will agree that the most important use is in more scientific management. In this area, we have just begun to develop our potential. Figure 1 represents my concept of an integrated data-processing system. The illustration shows the requirements of a research and development organization. The system can be expanded to include other submodels necessitated by other types of organizations. The entire concept is oriented to four functions titled "Plan, Record, Measure and Manage" surrounding Operations. Each

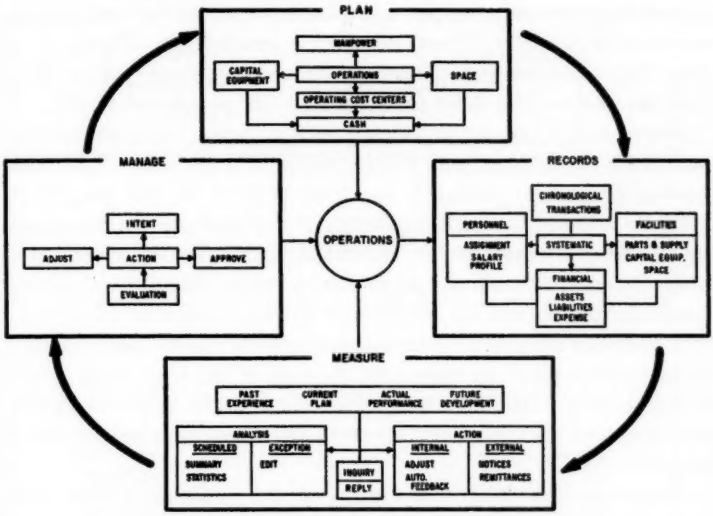

Figure 1. A total system for administrative processing

function has its integration with the other and in addition has its own set of interrelationships. As this illustration is discussed, please bear in mind that I will be talking about my experimental work with an R and D organization.

Plans are detailed presentations of management intent. In developing a plan, both long-range and short-range experience is used in combination with management judgment. The computer extends the detail along with the input modifiers, representing future goals. Requirements for space, capital equipment, and manpower stem directly from the type of operations to be performed. The operating cost centers reflect the experience mixtures of costs for the endeavors—that is, the 6–3–1, 4–4–2, and so on, mixtures of labor, materials, and burden for the different endeavors. Some combination of up to fifty cost centers are used in the over-all planning, as contrasted to a possible 300 to 400 actual expense classifications.

Records reflect plans and operations and establish a basis for the various categories of measurement. Transactions are all

recorded as they enter to provide a basis for audit, reconstruction, and systems analysis. They are then systematically dispersed to affect the necessary and proper records without any duplication. Here we observe the three submodels of the integrated system.

Measurement criteria are shown in the upper block within the box. Note the time consideration, which is a pressing, but often overlooked, system demand; our performance in the present is critically affected by our knowledge of the past and our concern for the future. Analyses are separated into those scheduled and others by exception. As an aid in the operation of administration, automatic action will be performed by the computer where criteria exists for the machine to determine requirement and remedy. Inquiry and reply is an important element of this integrated information system. The knowledge and effectiveness of management will be served through direct access to the collected administrative spectrum.

Management with its knowledge of the goals, problems, and conditions evaluates the product of the system. Emphasis on the various aspects of the computer processing system must not be allowed to understate the supreme importance of human contributions. The activities of the system are controlled by and performed for the people. Management may take action based on the machine's communication, to adjust plans, operations, or records—to approve the course of activity or simply stand advised of the conditions. Management intent is implicit in action taken and its effect upon plans completes its administration cycle.

Now briefly let us expand the type of operations to be performed in each of the personnel, facilities, and financial models referred to under "Record."

Personnel in Figure 2 covers the hiring, placement, pay, and control of benefits for people. This area is perhaps more heavily prone to information-retrieval techniques than to data-processing techniques. Personnel analyses show the progress of manpower employment against the established plan and salary increase progress or patterns. Inquiry and reply will provide management with a faster, more comprehensive, and more intensive analysis of personnel than has yet been possible. The total number of pattern searches which are practical increases significantly when performed

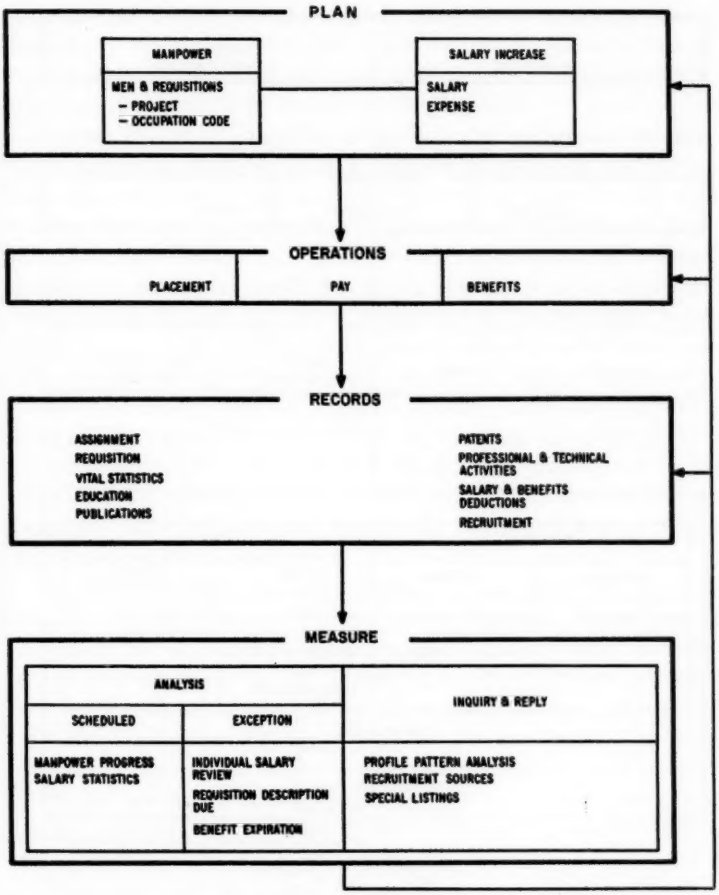

Figure 2. Personnel model

by a computer, as do the correlation possibilities in one integrated administrative file.

Facilities in Figure 3 include the maintenance and procurement of capital equipment and the procurement and storage of services parts and supplies items. Facilities measurements will lead to such scheduled analyses as stock turnover and vendor performance.

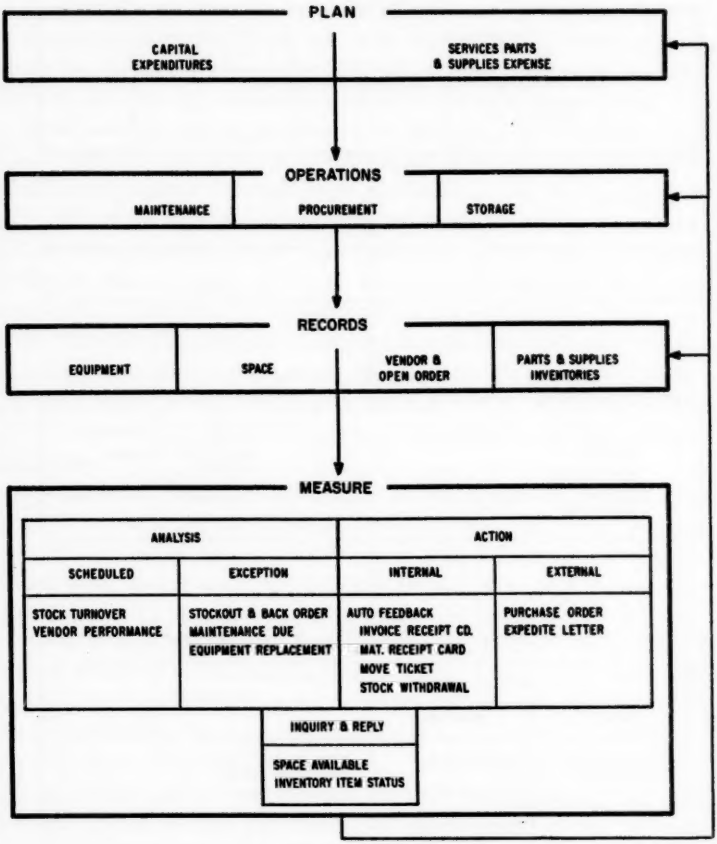

Figure 3. Facilities

Exception reports will be issued when maintenance is required or when equipment needs to be replaced due to maintenance costs. Automatic action will be especially important in the facilities area. Internal action is represented by the invoice receipt, material received, move ticket, and stock withdrawal. Each of these actions is prepared for automatic re-entry into the processing system when the requisite actions have been accomplished. Many hours of

manual effort will be eliminated along with numerous files. Externally, purchase orders and expedite letters will be executed by the computer. On inquiry, information such as space availability or inventory item status will be provided.

Finance in Figure 4 includes all areas of the budget and accounting for expense. Here we should note the necessity for combining both the nonfinancial and financial operations. Only through this combination can we get an accurate analysis of our financial position. Not only do we want to know the past experience, reduced to the common denomination of the dollar, but we must know the future effect on our monetary resources for people either being hired or retired, the reorder of supplies, procurement of assets, etc. The analyses of the expense, commitment of expense, and extrapolation of future expense when compared against the plan leads to the integration of dollar variance patterns and the effect thereof by activities in other areas of the business. The results lead to the automatic adjustment of cash requirements for the future. In addition, the financial model handles the payroll, payment of bills, audit procedures, and the like.

In order to reach our full capabilities and best use the tools available to us, we need to integrate the total administrative functions into a single autonomous system. As an entity the ability to develop this kind of integrated computer model has even greater implications: *(a)* Through the storehouse concept, it removes duplication. *(b)* It permits any correlation of data. *(c)* It provides a simulation model to assist in making the best possible decisions among several alternatives. The increasing interests in these principles is evidenced by the theme of this convention—integrated and automatic data-processing systems.

Now, where do we as individuals fit into the picture. The integrated data-processing system provides a storehouse of historical, current status, and planning records, together with the ability to process, simulate, search, request, and display information. The people associated with the system are divided into two categories: *(a)* those working with internal activity and *(b)* those working with external activity. Internal activity involves error correction, monitoring or performing a simulation based on the known data

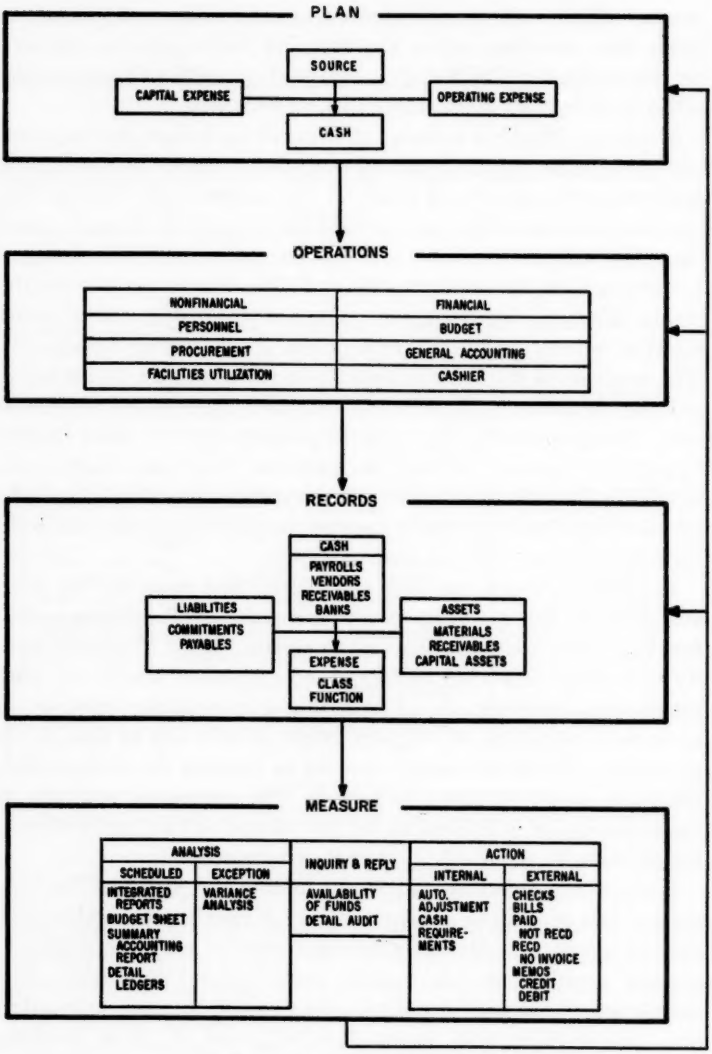

Figure 4. Financial model

contained within the storehouse, not coding and audit. External activity involves performing an intelligence function to feed external factors for comparison with and against internal activity.

I believe that accounting should become a general intelligence unit feeding external factors to the computer for comparison. This type of analysis will improve planning and control. The more perfect accounting system could be created through the storehouse concept of data processing, with a strong-arm intelligence unit.

In the development of an integrated system, I strongly recommend starting with a study of the whole system before proceeding to the execution of any of its parts. The plan of execution can then be phased according to the available resources. It has been my experience that the time required from original concept to the operating system is in the range of five to eight years.

At this point I would like to develop one part of the analysis and planning system. Let us look at the operating budgetary control system of the financial model in Figure 5. This system includes the current budgetary control, adjustment, and projection cycle. The right-hand portion of the flow diagram pertains to current control. The left-hand portion pertains to adjustment. The by-products of these two operations lead to the budget projection. We start first with the output of accounting as the input to the system. Our plan later can be to go back and integrate each of the accounting applications directly into the system. Since we know more about how to do the accounting part, let us start with the financial planning phase of operations. Because we are working with an R and D organization and knowing that the salaries of personnel represent approximately 60 per cent of the operating expense, it is necessary to integrate personnel changes with the over-all expense picture. As the current transactions are fed into the processor, the accrued effect of the expenses are compared against the system's pre-established plan. Whenever the expense exceeds a definite criteria, an expense control memoranda is produced. This criterion is a variable, independent of the main program; it can be changed to conform to policy without rewriting the program.

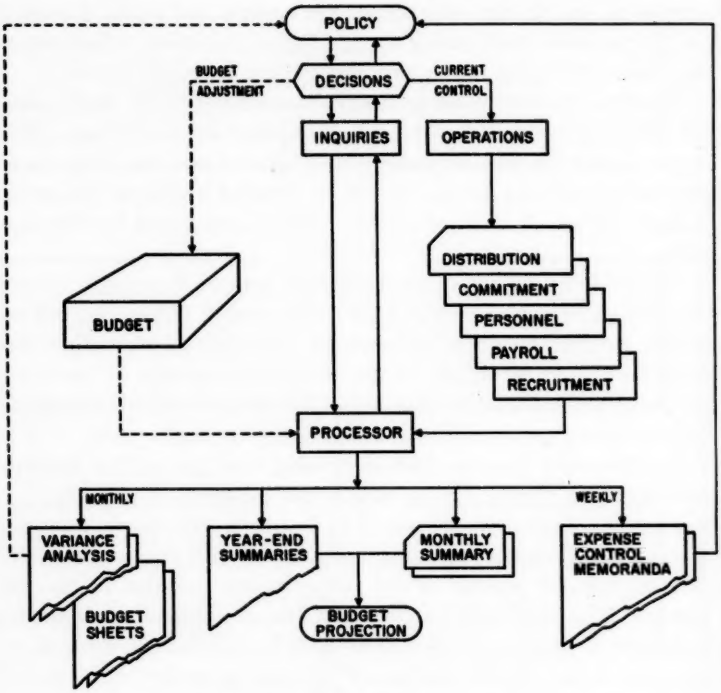

Figure 5. Budgetary control

Periodically, the machine performs a complete analysis of all components of cost and produces variance analysis by exception. Following evaluation, either the operations could change or a budget adjustment could be fed back into the system to adjust the standard. Figure 6 shows the criteria for the variance analysis. Reports are produced only when a decision appears to be necessary, as determined on the basis of the following tolerance test: the value of the year-to-date variance (V) squared, is compared with K times the year-to-date budget (B) to isolate instances where $V^2 \geq K\ (B)$. The controller has complete freedom to change the value of "K," which in effect either tightens or loosens control. For example, if "K" were equal to 100, the allowable plus or minus tolerance for an allocation of $100,000 would be approxi-

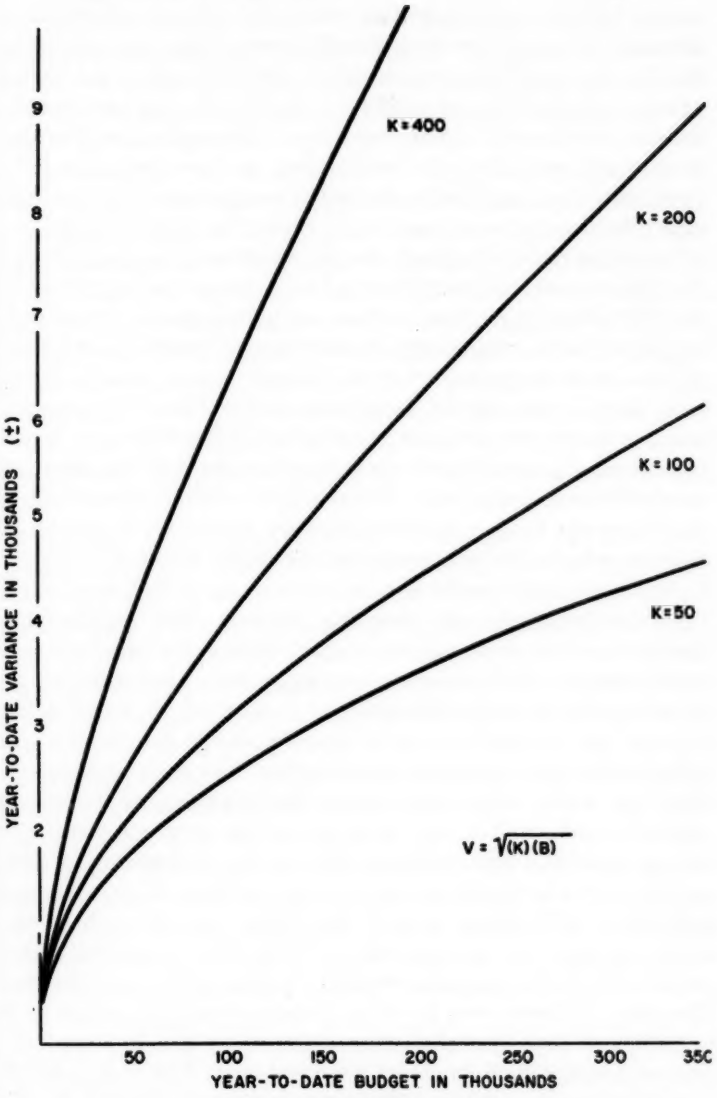

Figure 6. Tolerance criteria

mately plus or minus $3,100. When a variance condition is detected, it must be communicated to the reader in a manner so that he can understand the causal factors. Therefore, the design of the communication provides for both the dollar variance and the indices which reflect causal conditions. The indices in this particular case were called the "base index," the "rate index," and the "cost index" to supplement the dollar comparison. These are per cent reflections of how far each varied from the original projection. The indices reflect the trend of cost and effort. The sign indicates the direction of shift and the number indicates the magnitude of the shift. If the signs for all indices are plus or minus, shortage or surplus of funds, respectively, is obviously indicated. For mixtures of signs, shifts in emphasis will be indicated among cost, base, and rate. Some trends require immediate plus or minus adjustments, and others may be consumed or converted, depending upon future conditions. The conclusions must be drawn by both the financial man and the technical man. The decision is either to maintain or to change the budget standard. Flexible budgeting is sought in order to get the greatest return for the dollar invested.

Although budget projection may be a rather complicated affair, there are but three basic elements involved. The required elements are short- term experience, long-term experience, and corrective factors which represent the management's judgment. Short-term experience can be visualized as an array of the actual dollar expense for the previous twelve months within each of the cost centers of project, program, or discipline. The long-term experience is a similar array, but reflects the increasing or decreasing trends for the past five years as an index. Let us take for example the occupancy of this building. One of the components of costs would be the fuel costs for heating the building. The short-term experience will tell us actually the dollar cost for each of the twelve months for heating this building. The long-term index would reflect the increasing trend in heating fuels across the past five years. If there were no other changes, except in inflation, it would show that the inflationary trend alone had increased the cost of heating fuels by 3 per cent per year. The index which would be found would be 1.03. However, the actual dollar experience times 103 per cent is not sufficient to produce an accurate

forecast. For example, we may know that 10 per cent additional space is to be added to this building. In this case, the corrective factor would be 1.133. This, when multiplied against the actual dollar experience, would give us a better forecast of dollar requirements for heating fuels.

The machine process performs the myriad of calculations. It takes the recorded history, together with the management intent, and develops a mixture of the costs, discipline costs, and total costs of operating the laboratory. The first output will be the tentative budget based on the input modifiers expressed to the computer. The computer process then becomes a simulation process of feeding other corrective factors of either additional or decreased manpower and other cost-related changes. This simulation process continues until the management is satisfied with an operating plan. Once this point is reached, we then "loop back" into the current control and adjustment part of the over-all financial planning cycle.

The kind of systems development work that I speak of here today has convinced me that we must face up to some of the critical problems if we are to continue our rate of progress. From my experience I would like to point out some of these problems:

1. We are hampered by the traditional and organizational requirements. The administrative organization has separate operating functions, each of which is an information center. Yet on the other hand we know that a decision made for one function has a "chain reaction" on other functions. In my opinion, business people need to evolve from the concept of "data supply" to "information demand," to fit the need.

2. Let us look at control. What profit effect does what we are measuring have on the actual operations? It is my opinion that we may have far too many controls to be effective. Techniques of measurement and control could be improved, through greater use of probabilities and statistics. Most challenging of all, is to define what we mean by control.

3. Let us speed up the use of exception principles by providing the proper criteria to establish the exception. Implementation of these principles will be slow until accountants provide better information.

4. Finally, we need to face up to the problem of education. We are moving into an era of data processing that will require our constant efforts. Even if we cannot see what is ahead as distinctly as we might like, this much we know: the fields of administration and data processing are dynamic. The business machines industry is an industry of change. It encourages, it introduces, and it produces change. Administration is under constant fire to reduce costs, yet provide better forecasts, better status measurements, and more scientific management.

We look to accountants to apply more stress on systems concepts. Although I could have described equipment to you, I chose to talk about how we might think of its use. Perhaps you will agree that the "state-of-the-art" of use falls behind development of the data-processing equipment.

Vincent R. Grillo, Jr.

Centralized Integrated Data Processing—By Communication

In any organization which operates from a number of different geographical locations there will be not only problems of direct communication but also problems associated with assimilation and control of data received from outlying locations by the central office or agency. Electronic equipment is now available which provides for direct integration of the communications system with a centrally located computer that functions as a fully automatic and constantly updated file. The types of messages handled by such a system consist of interrogations which require an answer from stored data, transactions which are to be recorded, and periodic summary reports which become available by tapping the computer's memory device.

Mr. Grillo is with Remington Rand Division of Sperry Rand Corporation.

A NEW and dramatic concept in data automation, developed to meet the needs of the United States Air Force, may well have a revolutionary effect on the administrative efficiency of large, widespread organizations in many other areas of governmental and industrial activity. Described as "centralized integrated data processing—by communication," the new technique is the result of several years of intensive research and development by the Univac Division of Remington Rand. What it accomplishes, in effect, is

capture enormous amounts of working data at their points of origin, however numerous and geographically far-flung those points may be, and assimilate the data into a centralized computer installation that functions as a fully automatic and constantly updated file from which rapid and comprehensive status reports are made continuously available.

The technique is designed to serve the Air Force as a command-base data-automation system; it will enable Air Force bases throughout the United States (including missile-launching sites, tenant facilities on other command bases, supply units, and other satellite organizations) to be linked in a constantly active communications and data-processing network with their command headquarters. Under the plan developed for Air Force use, a Univac computer serves as the centralized data-processing equipment. The method is equally suited to the Univac real time computer, the Univac file computer, the Univac solid state computer, and to large-scale systems such as the Univac III and Larc systems.

There is of course nothing new in the idea of centralized data-processing facilities tied into a wire communications network. Under conventional procedures, however, incoming messages from the field must pass through a number of peripheral operations—sorting, collating, sequencing, and so on—and must sometimes be transcribed from one code media to another before they can be fed to the computer for processing. These time-consuming functions can be wholly eliminated under the Air Force plan, owing to the use of the new automatic data link equipment. Working on-line with the computer, the data link automatically receives and transmits messages between the computer and any number of distant locations. It consists of three separate components: a multiplexer section, a format-control unit, and an input-output adapter. Wire communications lines to the field are connected to as many as sixteen teletype substations near the central computer, each equipped with a high-speed paper-tape sensing and punching unit. The data link's multiplexer section is designed to switch-connect any one of these substations to the computer for the receipt or transmission of a message.

A complete incoming message is buffered into a paper-tape loop.

The last character received, the end-of-message symbol, causes a pulse to be transmitted from the receiving punch to the multiplexer which then closes a connecting switch between that particular substation and the data link machine. The sensing-punching unit within the substation is then activated and the message is read at sixty characters per second through the format-control unit through the input-output adapter and into the buffer of the Univac computer. Once within the system, the full weight of computer logic can be brought to bear on the message, and automatic decisions on its disposition can be made.

All of the myriad messages handled by the system can be classified into three basic types: interrogations which require an answer, transactions which do not, and summary reports which must go either forward to the command headquarters or out to the local reporting elements. Interrogations coming into the system are instantly identified as such, the memory location of the record containing the answer is automatically determined, and a high-speed interrogation of the computer's random-access-memory storage is initiated. The vast amount of information that can be stored with the computer's random-access memory can include a master inventory file, master personnel indices as required for project automate, dollar balances of appropriation accounts, or an almost infinite variety of other status data. In addition to drum storage, moreover, still other data can be stored in the form of magnetic tape files. Transactions requiring no answer, can merely be recorded on tape and held to be processed at a later time. Complete summary reports are made available simply by tapping the computer's memory at the end of each data-reporting cycle.

Advantages of the system to the over-all efficiency of the Air Force command can be itemized as follows:

1. The rapid response potential of the on-line automatic data link provides capability for a living nerve center of communications and data processing.

2. The real time or on-line communication and random-access features of the system reduce the validity of previous objections to centralized record keeping; they make practical a centralized data-processing center at which substantially all base accounting can be performed.

3. Data captured at its point of origin may be radiated upward through the entire Air Force accounting structure without the need for repeated retranscriptions of information at many levels.

4. The total resources at the disposal of base command may thus be known and utilized more effectively. No longer need there be a lack of knowledge of the disposition and balance of vital segments of total potential.

5. The area of jurisdiction of the centralized computer system may now encompass a region the limits of which are determined by transaction volume and logic, rather than by arbitrary geographical factors.

6. The features of random access to internal memory may be employed by updating certain of the currently maintained summary reports on a daily basis. In addition, this feature may be even more effectively exploited by the development of new reports that generate more important data than is presently maintained.

The system, in short, can now provide the all-important element of "time compression" in the generation and delivery of current, accurate facts to the Air Force base command personnel—facts which are used as the basis for making more effective administrative decisions at all levels.

Lieutenant Colonel Charles H. Greene, Jr.

Marine Corps Personnel Management Data-Processing System

In order that the widely separated units of the Marine Corps can be operated efficiently and economically, it is necessary that management at all levels be supplied with appropriate personnel data that is current and accurate. To achieve this objective the Marine Corps is putting into operation three computer systems. Two of these are at the major bases, Camp Pendleton and Camp Lejeune, and their function will be to consolidate all personnel information on a daily basis. The third is at the Marine Corps Headquarters. Here weekly changes will be recorded in the master file. As a result of the introduction of the computers, personnel changes are reflected almost immediately. Thus timely and accurate information is available for both current decisions and forecasts of future manpower requirements and resources.

Colonel Greene is Program Coordinator, Marine Corps Personnel Management Data Processing.

TO operate far-flung Marine Corps installations at least dollar cost, management echelons must make accurate and timely decisions. Such decisions are impossible without accurate and timely information. It is the function of our Personnel Management Data Processing System to provide such information on our personnel resources. The purpose of this presentation is to outline for you the system development, concepts, objectives, equipment, pro-

gram development, and the status of conversion and implementation.

Although the Marine Corps has been a user of punched-card machinery for some time, our program for effective data processing began with the formation of a Data Requirements Committee, at Headquarters, Marine Corps, in December 1954. The committee was headed by General Shoup, the Fiscal Director at that time, and consisted of members from the principal data-using staff offices of Headquarters, Marine Corps. The mission of the committee was "to review and appraise all accounting and data processing requirements of the Marine Corps, including personnel accounting, to eliminate duplication; to ascertain that results are adequate and timely, to insure that the Marine Corps keeps abreast of the latest developments in methods and equipment."

This committee did considerable exploratory work in the definition of the problem. However, its members soon came to the conclusion that the work was of such magnitude that it could not be done by people working on a part-time basis, and in June 1955 recommended that a full-time board be established. The Board was convened in August 1955 with a mission to: "1. Establish the data requirements for effective Marine Corps administrative operations" and "2. Determine the most economical means of developing that data; whether it be by manual, mechanical, electrical or electronic means." During the twenty-two months of operation, this board completed studies in eight major accounting areas, one of which included the entire area of Personnel Management Data Processing. In addition, they selected the National Cash Register Company's Model 304 Electronic Data Processing System, as the means for solving our data-requirements problem in the area of personnel management.

Upon approval of its final report, the Board was dissolved on June 25, 1957, and the functions reassigned to appropriate staff agencies. The Office of Program Coordinator, Electronic Data Processing for Marine Corps Personnel Management Data Processing, was established to continue the detailed study of the problem and completion of necessary programs. Thus a system was designed and instructions for the computer written, and we are now in the

process of converting our manual and mechanized files to magnetic tape records. The details of this process will be discussed later.

PRESENT OPERATIONS

Our present system of processing personnel data is essentially a mechanized-manual operation. We have some two thousand units reporting information about personnel to eighteen field data-processing installations (punch-card machinery). The reporting unit prepares a diary of occurrences and forwards this information daily to the appropriate data-processing installation. At the installation, an analyst codes, audits, and updates his punched-card files on a daily basis. At the end of each month, the eighteen data-processing installations consolidate and prepare summary cards and reports for forwarding to Headquarters, Marine Corps. The summary cards are consolidated and additional reports prepared, while the hard-copy reports are manually assembled and data verified and extracted for preparation of final reports. These reports are generally available to the users some 45 to 50 days after the month-end cutoff.

Both these systems are slow and costly, in time and in money expended. The fact that the first, the mechanized portion, must complete its cycle before the final (manual) action can start makes our management reports sadly out of date by the time they are in the hands of the users. In addition, this is a one-way communication channel, with little or no feedback to facilitate efficiency or support to the operating forces.

PLANNED OPERATIONS

Installation of our three computer systems commenced in December, 1959. The first was installed, for Marine Corps use, at Camp Pendleton, California, on December 14, 1959, the second at Camp Lejeune, North Carolina, on January 25, 1960, and the third at Headquarters, Marine Corps, on May 12, 1960.

The installation of the computers does not really change the present system of reporting personnel information. This was deliberately planned to avoid implementation problems. We have linked the reporting units through the data-processing installa-

tions (present system) and connected them with the two field computers on the East and West Coasts. The major Marine Corps bases, Camp Pendleton and Camp Lejeune, will each form a center for the consolidation of personnel information on a daily basis. Once each week, the changed records will be airmailed to the Headquarters' installation, where the changed records will be merged and posted to the master record file, along with changes that have occurred, during the week, at Headquarters.

Note at this point, the change in the communication pattern. Under our present system, a change generated at Headquarters, i.e., transfer order, promotion, MOS change, and so on, is not reflected in the present system until it arrives in the field command, is made a matter of record in a diary entry, and finally some six weeks later, the fact is reflected in reports generated out of the system. The new system will permit the recording of a change almost immediately and reflect actions of personnel managers on Monday of each week for their previous week's activities. In addition, we will have the capability of projecting command strengths three to five months into the future, so that transfer orders may be planned to keep the many commands at optimum strength as a normal course of business.

Data processing for the Reserve Establishment is organized essentially the same as the Regular Establishment, i.e., diaries for Organized Reserve Units are submitted to the Reserve data-processing installations for processing, updating of their files, and forwarding of changes to the field computer centers. Summary cards are forwarded to the Headquarters computer on Volunteer Reserves. With these basic files, and other files to be processed on the Headquarters computer, we will have attained our goal of integrated data processing for the personnel management application.

As a result of releasing the eighteen data-processing installations from their requirement to prepare output for Headquarters, they can satisfy local reporting requirements. The field computers can prepare consolidated reports which can be transmitted back to major commands which require them, over the same electrical network over which the changes were forwarded. In the field, these reports will be current daily, rapidly available, and precisely accu-

rate and will reduce administrative workload of the commands affected to a marked degree.

OBJECTIVES

Our primary objective in the system design was to provide for timely and accurate summary information and forecasts of future manpower requirements and resources. Second, since we will have identical records at all three computer installations, we have ensured availability of records and will have the capability to use them should one installation be destroyed. Our third objective is concerned with mobilization. A heavy burden is placed on personnel officers at all echelons during the time a division, for example, is being prepared for mounting out. When this problem is magnified by the requirements of full or partial mobilization, the work load, and often the confusion, is tremendous. Thus without additional equipment, we will have the capability of providing necessary information to support such eventualities. Fourth, we have provided for maximum capability for service to Headquarters agencies and other accounting areas within the framework of integrated data processing. The fifth objective, by design, will provide a maximum service to field commands because of the availability of punched-card equipment as well as the computers to the commanders requiring these services.

EQUIPMENT

The Marine Corps must maintain records on some 200,000 people in the Regular Establishment and on another 250,000 in the Reserve program. Our present system, at best, provides approximately 40 items of personnel information. The 304 System has, for most purposes, an unlimited capacity. We are planning to include an average of 150 items (400 characters) of information on each Marine in the master tape record, and we can store 250 characters of information on each inch of tape. The entire master personnel file will occupy only seven reels of tape for the Marines on active duty. From these records, we can read or write information, for processing, at speeds approximately 35,000 characters per second. This, coupled with the fantastic internal speeds, provides us with large-capacity operations at a reasonable cost.

In addition to the programmed audits, the 304 System has provided an automatic check from the initial input to the final report, to guarantee, with exceptional accuracy, that the data is being processed through the entire cycle without error. In summary, this is a high-speed system capable of handling a large volume of routine data, either through the processor (on-line) or independent of the processor (off-line), or the two can be operated concurrently —a tool which facilitates complete integrated data processing of personnel information at any one of three central locations.

PROGRAMS

Standardization of equipment at the three installations has permitted efficient production of approximately 220 programs for personnel data processing. Programs are standardized so that they can be processed at any one of the centers. These programs include conversion of manual and/or mechanized records, file maintenance of the master records, and the reporting process. Conversion programs have been completely tested at Camp Lejeune, and we are now processing in the interim-file maintenance phase.

Since December 1959 we have assembled all of our field-file maintenance programs at Camp Pendleton, and have completed 90 per cent of the program-testing phase. This portion was completed July 1, 1960. The assembly and testing of Headquarters programs commenced on May 12, 1960. On July 1 we commenced conversion of certain mechanized files maintained at Headquarters, Marine Corps.

A new individual record card (IRC) has been developed to provide additional items for each record. Reporting units will commence submission of these in July and posting to the master record accomplished during August through November. Finally, in December the information prepared from individual case research, at Headquarters, will be posted to the record. At this time, the master records at all three installations will be complete, and normal processing will be established.

SUMMARY

The first phase of planned implementation of the Marine Corps Personnel Management Data Processing System will be fully oper-

ational by the latter part of this year. It is worth-while to summarize the dividends we anticipate from this stage of the over-all program.

First, it will give us increased military effectiveness, through more realistic planning of our manpower requirements and improved forecasting of personnel availabilities. It will enable us with far greater certainty to put the round pegs in the round holes and the square pegs in the square holes. These factors will lead to improved personnel utilization, reduced personnel turnover, and increased dividends from our investment in personnel training.

Second, it will give us the facility—in the form of accurate, usable information—for producing more realistic and accurate budget estimates and for maintaining more effective control over our obligations and expenditures.

Finally, because we will have accurate, up-to-date, and accessible information concerning our personnel resources, it will give us increased flexibility to respond rapidly and effectively to changing requirements growing out of changes in the international scene or national policy.

We do not expect miracles of this system. The solution to our problems will always depend finally upon exercise of sound human judgment. But, on the other hand, we confidently believe that such a system can, by freeing our policy makers, planners, and clerical forces of the drudgery of routine, give them time to think. It can guide them from needless error and provide the information necessary to support the most logical decisions of which they are capable.

Timothy E. Russell

Technical Accounting Developments

ADDITIONAL WITHHOLDING OF TAX ON WAGES UPON AGREEMENT BY EMPLOYER AND EMPLOYEE

BUREAU of the Budget Circular No. A-26, revised, dated May 2, 1960, updates references to the United States Code and the Federal Register relating to the additional withholding of income tax and provides that in order to utilize pay tables to the extent applicable and otherwise facilitate payroll and audit work, the following policy should be adopted when additional withholding of tax is involved.

1. Except as provided in paragraph 2, the amount of tax presently withheld plus the additional amount requested to be withheld each pay period shall conform to one of the amounts shown in the tax withholding tables as set forth in Section 3402 of Title 26 of the United States Code. For example, if an employee now has three exemptions, he may request that an amount be withheld equivalent to "2," "1" or "0" exemptions.

2. In those cases where withholding is requested in excess of the amount provided by the "0" exemption, the amount to be withheld shall be that which may be agreed upon by the employing agency and the employee. Such withholding, however, should be a constant amount for each pay period.

RESTORATION OF BALANCES WITHDRAWN FROM APPROPRIATION AND FUND ACCOUNTS

On July 9, 1960, the Bureau of the Budget rescinded Circular No. A-23, dated June 21, 1957, which required special reports whenever there was a restoration of withdrawn appropriation or fund balances. The statutory requirement for special reports was eliminated by enactment of Public Law 86-533 (74 Stat. 245). Restoration of balances will continue to be reflected in the regular reports under BOB Circular No. A-34. Each agency, however, should be prepared to provide an explanation, upon request, of the circumstances relating to any restoration of balances.

UNIFORM CLASSIFICATIONS ACCORDING TO "OBJECTS"

Bureau of the Budget Circular No. A-12, dated July 22, 1960, prescribes a uniform classification to be used in classifying the government's financial transactions by object class and replaces Part VII of the Budget-Treasury Regulation No. 1. The relationship between the new and former classifications is set forth in an attachment to the circular. The new classifications prescribed by the circular are applicable beginning with the 1962 Budget.

The revised classes are based upon the nature of the services, articles, or other items involved, as distinguished from the purpose for which such obligations are incurred. For example, personal services or supplies are to be classified as such even though they may be used in the manufacture of equipment, in the erection of structures, or in carrying out a grant program which involves the furnishing of services or materials rather than cash.

The classification prescribed by the circular shall be utilized in submitting budget estimates to the Bureau of the Budget and in reporting data whenever an analysis by object is required. The classification will be applied to obligations, applied costs, accrued expenditures, or disbursements, as may be required. In accordance with section 113(a) of the Budget and Accounting Procedures Act of 1950 (31 U.S.C. 66a), it is expected that agency accounting systems will be so designed as to provide the information required by the circular.

INSTRUCTIONS FOR THE PREPARATION AND SUBMISSION OF ANNUAL BUDGET ESTIMATES

Bureau of the Budget Circular No. A-11, which contains instructions for the preparation and submission of annual budget estimates, was revised on May 9, 1960. All sections of the circular have been reprinted whether or not a change has been made, so that previous issuances may be destroyed. Major changes: *(a)* the summary and highlight memorandum is to set forth forecasts of new obligational authority and expenditures for three years succeeding the budget year, rather than two years; *(b)* policy statements have been added concerning assumptions with respect to price levels for the budget year, reimbursements for hospital care, wage-board pay increases, the full-year cost of new positions established in the current year, and special foreign-currency programs; and *(c)* amounts in the budget submission will usually be rounded to thousands of dollars.

INSTRUCTIONS RELATING TO APPORTIONMENTS AND REPORTS ON BUDGET STATUS

Bureau of the Budget Circular No. A–34, which contains instructions relating to apportionments and reports on budget status, was revised on July 19, 1960. All sections of the circular have been reprinted, whether or not a change has been made, so that prior issuances may be destroyed.

The changes made are primarily to simplify the apportionment procedure. For example, apportionments of appropriations or funds which do not expire for obligation at the end of the fiscal year will remain available until a new apportionment is made. Provision is also made for automatic adjustments of apportionments in certain cases which will further reduce the number of apportionment forms to be processed. The revised circular directs attention to the need for co-ordinating initial apportionment requests with the over-all financial plan of the agency, including employment levels and expenditures expected to occur; clarifies the definition of certain terms; and contains other instructions of interest to financial management people in the federal government.

GAO AUDIT REPORTS

Arrangements have been made for the General Accounting Office to furnish the Library of Congress copies of its audit reports that are unclassified and addressed to the Congress. Reports previously issued have been furnished and future reports will be furnished as they are issued. They will be included in the Library's permanent classified collections and will be catalogued and accessible to users of the Library.

COST INFORMATION IN THE BUDGET PROCESS

The *Congressional Record* for May 12, 1960, page 9484, contains some interesting remarks by Congressman Lipscomb of California on the subject above. The Congressman reviews events leading to the enactment of Public Law 863, 84th Congress; progress made in putting that statute into effect; and the significance of this legislation toward improving fiscal management in the government. Part of the Congressman's remarks are quoted below:

Probably one of the most significant features of Public Law 84–863 is the requirement that: "For purposes of administration and operation, such cost-based budgets shall be used by all departments and establishments and their subordinate units. Administrative subdivisions of appropriations or funds shall be made on the basis of such cost-based budgets."

In terms of application to Federal agencies, this means the installation of a coordinated programing, budgeting, accounting, and reporting system that gives appropriate attention to costs of operations as well as obligations or fund control. It requires that the financial plans of operating units be constructed on the basis of the full cost of planned programs in relation to the available resources on hand; and that those plans give recognition to the timing of the obligation of appropriated funds, the receipt of goods and services, and the application of available goods and services to the planned programs. After approval of such plans by appropriate review authorities, internal cost-based budgeting involves the use of an accounting and reporting system that provides adequate fund control and measures actual operating results against the approved plan in such terms as unit, activity, and organizational costs. These kinds of data will furnish management at the various levels in the agency with a sound basis for meaningful program

and operating decisions. From the standpoint of efficient and effective financial management, this type of system is as appropriate for the small administrative agency as it is for the large scale construction operation.

This goal, the effective management use of significant financial data in all agencies, is the all-important end objective of the modernization program now underway. The most important advantage to be gained is the effective conduct of agency affairs at a minimum cost. To do this, agency management must have available to it the costs of operations within a given time period, to permit comparisons of the performance of similar offices and functions during the same period, or of the performance of the same operating unit in different time periods. This approach, properly applied, contributes to the development of a cost consciousness among the operating managers in an agency. Practices such as these highlight the need for efficiency and place a premium on carrying out programs at less than the planned cost.

To summarize, the Federal agencies today are in the midst of a transition to a more modern, businesslike method of carrying out assigned functions. They are installing accrual accounting to provide more pertinent financial data on agency activities; they are adopting planning procedures that give more attention to costs and the effective use of available resources; they are developing related reporting practices that provide more significant operating and financial data for management use; and they are presenting these additional data in support of appropriation requests to furnish more complete disclosure of actual results and the planning factors used in developing such requests. These improvements can contribute greatly to more effective program, budgeting, and operating decisions.

INFORMATION ON AGENCY FINANCIAL MANAGEMENT IMPROVEMENT EFFORTS

Bureau of the Budget Bulletin No. 60–7, dated May 21, 1960, requires each agency to submit information on its financial management improvement activities for the Annual Report of the Joint Financial Management Improvement Program for fiscal year 1960, for publication in the latter part of the calendar year 1960. Narrative information is to be provided on (*a*) the status of the agency improvement program as of June 30, 1960, with specific reference to accrual accounting (including monetary property accounting), allotment simplification, synchronized classifications

for programming, budgeting, accounting and financial reporting, and cost-based budgeting; (*b*) accomplishments during fiscal year 1960; and (*c*) plans for future improvement. The bulletin also requires a tabular presentation regarding the status on June 30, 1960, of the attainment of the major accounting and budgeting objectives of the program.

In regard to "status," brief but descriptive narrative statements are required to reflect the degree and manner in which the agency has progressed in the modernization of its financial management system. For example, in respect to accrual accounting, each agency is required to indicate whether suitable monetary property and other accounting records have been installed, whether accrual information (including cost data) is being developed and the manner in which this is done, and whether Comptroller General approval of the accrual system has been obtained. Similiar specific statements are required for the other improvement areas; and, in addition, accomplishments and future plans are to be described so as to provide a clear picture of the agencies' improvement program. The Bulletin requires that the narrative material be reviewed with General Accounting Office representatives in the same co-operative manner as in previous years.

COST-BASED FINANCIAL MANAGEMENT ILLUSTRATIONS

In order to promote better understanding and more familiarity with the potential value of cost information as a management tool, the Bureau of the Budget initiated action under the Joint Program to develop and organize a series of presentations that would demonstrate agency experience in the application of cost-based financial management techniques. That action was based on the premise that such presentations would be useful for training purposes within the agencies involved as well as for staff of other federal agencies. It was also visualized as a first step toward the development of more definitive government-wide criteria in this field.

Based on the kind of program conducted, the nature of the financial management system employed, and the experience gained, several operating agencies were requested to participate in this

undertaking. Those organizations that were contacted co-operated wholeheartedly in this activity. They included the Atomic Energy Commission, the Veterans Administration, the Bureau of Reclamation in the Interior Department, the Bureau of the Mint in the Treasury Department, and two separate elements of the Department of the Army. The two program areas in the Department of the Army were the Corps of Engineers civil functions, and the operation and maintenance area of the military functions.

In each case, the operating agency staff developed an oral and a written presentation, employing visual aids, demonstrating their own application of modernized financial management concepts, and illustrating how the system operates to serve the organization's management needs. Presentations were made to a number of staff groups in the Bureau of the Budget. Consideration is also being given to similar presentations of the material before staff groups in other agencies, before other interested groups such as the professional societies, and in the Civil Service Commission's Financial Management Institute.

PROPERTY INVENTORY REPORT

The House Committee on Government Operations has issued its fifth inventory report, entitled "Federal Real and Personal Property Inventory Report (Civilian and Military) of the United States Covering Its Properties Located in Continental United States, in the Territories, and Overseas as of June 30, 1959." The information for the report was furnished by the Department of Defense, on its real and personal property; by the Department of the Interior and the Department of Agriculture, on public domain acreage, including mineral resources; by the General Services Administration, on most other real property; and by the Treasury Department, on the personal property of the civilian agencies.

Real property is reported as of June 30, 1959, at $71,756 million and personal property at $192,808 million including military equipment and supplies. Federal personalty (exclusive of cash and related cash items) is reported at acquisition cost. Federal realty is, for the most part, at acquisition cost. Public domain and property acquired as gifts or without cost to the government are shown at estimated present-day values.

SIGNATURES ON REPRODUCIBLE MASTERS

The Comptroller General in a published decision (B-142971, July 6, 1960) approved a proposal of the Department of the Air Force to permit the contracting officer to sign reproducible masters of DD Form 1155 for purchases amounting to $2,500 or less. He advised that the interests of the government appear to be adequately protected by the contracting officer's manual signature of the reproducible master. He suggested that the department, in changing its directives, should emphasize that the contracting officer's signature, when reproduced on the required number of copies, carries the same force and effect as the pen and ink signatures heretofore used. Each copy intended to serve as an original should be marked "duplicate original."

FLIGHT INSURANCE

The Comptroller General has also ruled that a government employee may not be reimbursed for the cost of flight insurance for an airline trip on official business. The Standarized Government Travel Regulations provide for reimbursement of incidental travel expenses only when they are necessarily incurred by the traveler in connection with the transaction of official business. The decision of the Comptroller General (B-143320, July 12, 1960) expressed the view that the purchase of insurance on the person of an employee while traveling is for his own protection and ordinarily is not to be considered to be an incidental expense necessarily incurred for the transaction of his official business.

H. Edward Breen

Current Publications

ARTICLES

Bernstein, Leopold A. "Over-all Checks in Auditing," *Journal of Accountancy,* 109 (June 1960), 36–41.

"As mechanized data processing makes it more frequently possible to reduce the time spent on detailed test-checks, over-all checks are likely to have greater relative importance in the auditor's work. They can also enhance the value of the audit to management and other users of financial reports. Among the over-all checks discussed are the commonly used ratios, unit cost comparisons, variance analyses and application of funds statements."

Boyce, L. Fred, Jr. "Installing a Medium-Sized Computer," *Journal of Accountancy,* 110 (July 1960), 48–53.

"What actually happens when a medium-sized company installs a computer? Do data processing costs go up or down? What are the real advantages? This account of a computer installation in one company provides important clues for business contemplating a similar step."

Campfield, William L. "The Expanding Role of Internal Auditors in the Federal Government," *Internal Auditor,* 17 (June 1960), 29–39.

"Evolutionary changes have been taking place in the role of internal auditing in the Federal Government. Two general aspects discussed in this article are the expanded role of the General Accounting Office as the audit arm of the entire Federal Government and the acceptance of professional type auditing within the Executive Branch of the Government. Mr. Campfield amplifies his discussion of 'The Expanding Role of Internal Auditors in the Federal Government' with specific examples."

Coughlan, John W. "Contrast between Financial-Statement and Discounted-Cash-Flow Methods of Comparing Projects," *N.A.A. Bulletin,* 41 (June 1960), 5–17.

"Pointing out that the financial-statement evaluation method stems from accounting data while the discounted-cash-flow method is specifically designed to compute return on investment, the author gives each of them an equal chance in the simplified case he develops. This reveals imperfections inherent to the financial-statement method, whether the computation is based on gross or net assets, and indicates the feasibility of the discounted-cash-flow method in choosing between alternative projects and in appraising past performance as well."

Dreiman, Roy N. "What a Utility Has Learned with EDP," *The Controller,* 28 (Aug. 1960), 362–370.

"A big electricity and gas supplier converts to electronic data processing, learning to apply it to a variety of tasks throughout the company, and gaining an outlook on further applications coming with new equipment."

Flewellen, W. C., Jr. "Concept of Depreciation Accounting Held by the United States Supreme Court," *Accounting Review,* 35 (July 1960), 413–421.

The author discusses the position on depreciation taken by the Supreme Court of the United States and after presenting cases involving valuations, determination of income, and many others concludes by stating that, "if one may generalize in the face of some diversity of evidence, it may be said that the United States Supreme Court has accepted original cost to the owner as an appropriate basis for the determination of income and for the calculation of depreciation charges. In accepting this generalization, however, diversity of opinions in dividend cases must be kept in mind."

Goudeket, A. "An Application of Replacement Value Theory," *Journal of Accountancy,* 110 (July 1960), 37–47.

"One of the major industrial organizations of the world, the Philips Company with headquarters in the Netherlands, has adopted replacement value accounting in financial reports to management and to stockholders. The firm's chief internal auditor explains the techniques which are used, with different indexes for fixed assets, inventories, investments and monetary assets. The objective, as described, is to approach as nearly as possible the economist's concept of income."

McConnell, Richard J. "The Philadelphia Story," *Journal of Accountancy,* 110 (Aug. 1960), 45–52.

"In ten years, Philadelphia moved from an antiquated method of record-keeping, with many records still inscribed by hand, to a modern system which is being looked to as a model by other large cities. Philadelphia's Director of Finance describes the principal features of the new system, including the auditing program, capital and operating budgets, refinement of accounting techniques, and special problems in the areas of water and sewer systems, inventory control, and real property assessment records. He emphasizes the need for greater attention to municipal financial problems from independent certified public accountants."

Mints, Frederic E. "New Developments in Operational Auditing," *Internal Auditor,* 17 (June 1960), 9–21.

" 'Operational Auditing' has come to mean many different things: non-financial audits, management audits, functional audits; and among others, it is used to mean a type of auditing and an area of activity to be audited. Mr. Mints discusses the history of operational auditing at Lockheed and the development of new applications, approaches and techniques. An Electra assembly study made at Lockheed is discussed in detail in illustrating the applications of these new techniques."

Morse, Ellsworth H., Jr. "The Case for Accepting GAO Experience," *Journal of Accountancy,* 109 (June 1960), 60–64.

"An auditor working for the General Accounting Office adheres to generally accepted auditing standards, maintains high standards of performance and is completely independent of the agencies he audits. The author believes that the nature of the work provides benefits to the CPA candidate comparable to those found in working for a CPA firm. The article suggests that each GAO candidate's case should be considered on its own merits as to whether his experience should be accepted as qualifying for the CPA certificate."

Murley, Kenneth J. "Expected Cost—The Common Denominator," *The Controller,* 28 (July 1960), 307–312.

This article explains "a concept permitting the presentation of costs in the financial statements and operating reports on the same basis and in the same amounts as for sales pricing, cost control and planning."

Pye, Malcolm L. "Reasons, Probabilities, and Principles," *Accounting Review,* 35 (July 1960), 437–443.

The author in discussing the establishing of an accounting court states that "an accounting court is a dubious method of arriving at an acceptable principle, since there are no laws (principles of accounting) which are to be used as a guide (the problem is one of establishing such principles), no method of appealing any verdict, nor any means of changing laws to obtain equity. Since the professed purpose of the court is one of establishing principles, it would seem that its function would be more legislative than judicial. Mr. Pye concludes that "what might prove useful for the best value judgment of all accountants is an extensive compilation and critical analysis of reasons that have been advanced through the years for the basic assumptions of accounting."

Simons, Harry. "What Accountants Think of Accounting," *Journal of Accountancy,* 110 (Aug. 1960), 35–44.

"Ninety-seven per cent of a group of young public accountants recently surveyed expressed satisfaction with their choice of occupation. However, 42% intend to leave the profession when they can make a favorable change. Among the most recent college graduates with accounting majors, those who entered occupations other than public accounting enjoyed a financial advantage. In earlier classes, those graduates still in public accounting had a higher median income. The various motivations for majoring in accounting, suggestions for improving accounting education and for making accounting a more attractive career are also covered in this report of a survey of UCLA accounting graduates 1946–1957."

Stans, Maurice H. "Current Improvements in Federal Budgeting," *Journal of Accountancy,* 110 (July 1960), 27–31.

"Although Congress has failed to enact the accrued expenditures limitations in appropriation bills which were recommended by the Hoover Commission and also by the Bureau of the Budget, improvements in the budget and appropriations processes have been achieved in other areas. Among these are reductions in 'back-door' spending without specific appropriations, extension of cost-based budgeting, and better control of foreign currencies received by the Government. Heading the list of needed further reforms recommended in this article by the Director of the Budget is authority for the President to veto individual items in appropriation bills."

Toan, Arthur B., Jr. "The Auditor and EDP," *Journal of Accountancy*, 109 (June 1960), 42–46.

"The spreading use of electronic data processing offers the auditor an opportunity to make his own procedures more efficient. After cautioning against auditing around the computer, the author points out that computer programs may be used very effectively in testing internal control. Furthermore, the availability of computers may make 'auditing by exception' much more practical in those areas where the development of quantitative criteria is feasible."

Wiener, Julius. "To Better Results through a More Accurate Break-Even Formula," *N.A.A. Bulletin*, 41 (July 1960), 5–18.

"Questioning the accuracy of computations and conclusions based on the conventional break-even formula, the author, after reviewing underlying elements and their functions, identifies some points, significance of which has been neglected in break-even analysis. He suggests that proper recognition of these considerations, as in the new break-even formula offered in this article, introduces into computations new factors, resulting in a higher degree of exactness."

Wright, Howard W. "New Department of Defense Cost Principles for Use in Contract Pricing," *The Controller*, 28 (Jan. 1960), 16, 17, 42, and 43.

"The Department of Defense recently issued a new set of cost principles for use in the negotiation, administration, and termination of supply contracts, whether of a cost or fixed-price type. These principles, identified as Sec. XV, Armed Services Procurement Regulation (ASPR), supersede both the old Sec. XV and those cost principles contained in Sec. VIII, ASPR. They are applicable, in some measure, to fixed-price contracts. No cost principles were applicable officially to this type of contract prior to the new principles. The new Sec. XV covers 25 printed pages compared to three and one-half in the old. Accounting concepts are substantially altered and the allowability of some items of cost is changed. This article analyzes the major changes in both the applicability of the new principles and in the accounting treatment of contract costs."

Book Review

John A. Postley. *Computers and People: Business Activity in the New World of Data Processing.* New York: McGraw-Hill, 1960. 245 pages. $6.00.

What has the advent of the computer meant to the day-to-day activities of ordinary people in business offices? This excellent and readable book by the head of the data-processing group at the Rand Corporation in Santa Monica attempts to answer this question. It is not addressed to the computer specialist or the engineer, but seeks rather to inform the businessman and the college student whose specialty is other than computers. It is not a "how to do it" book; instead it attempts to look behind the *how* at the *why*. Because of its perspective, we believe it will be read with interest not only by generalists but also by engineers and other computer specialists.

The author points out that

people like computers because they are modern, or mysterious, or prodigious, or because they think they save money (which they rarely do); people are rarely interested in computers because they know that the machines will open the door to the entirely new techniques of business operation and control which are so vitally needed in our increasingly complex business society.

Indirect cost savings (as by reduction of inventory levels) due to better and faster data processing through use of computer systems are described as far more common (and generally more significant) than direct reductions in data-processing costs.

Computers do not integrate systems functions, although they often provide the *means* to integrate operations when integration is a desirable objective. The use of large-scale computers need not bear at all on the decision as to which management system should be employed, although it may make *feasible* either centralized system management or dispersed system management.

Institutional and individual inertia, together with the substantial lack of knowledge about the many single operations which make up the complex

business systems of today in the business world, are the major roadblocks which lie ahead. Although our knowledge about these operations and their interrelationships is increasing at a rapid rate, it seems likely that the art of applying digital computers to problems, and not the art of engineering the machines to do the jobs assigned to them will (continue to) be the limiting factor in digital computer use.

He mentions the fact that work is under way toward a universal programming system, under which a program could be written to solve a given problem on any of various makes of computers of adequate capacity. Readers who desire more information on this work should obtain a copy of the *COBOL Report* (published April 1960 by the Government Printing Office) which describes such a machine-independent computer programming language.

In a great many computer installations, he says that the output still consists of reproducing for human perusal (and presumably verification in some cases) the contents of the files of the machine system. This kind of production of a flood of printed reports tends to drown management with more data than they have time to look at. Part of the reason for this is that people (and especially accountants) are not yet accustomed to accepting summary information from machines without concurrently receiving the details to support the summary.

It is likely that in most organizations an extended transitional period will be required before a sufficient level of confidence in the computer will be built up so that summaries will be used as the basis for action, with detail being printed out only on a sampling, or as required, basis.

This is a stimulating book that contains much food for thought, presented in very readable language. Unfortunately, it does not contain a bibliography or identification of sources for the findings stated.

HOWARD W. GAMMON

Department of Defense